RHYNCOTA. ORTHOPTERA.

SKETCHES

OF

BRITISH INSECTS

A HANDBOOK

FOR

BEGINNERS IN THE STUDY OF ENTOMOLOGY.

BY

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Dedication.

TO

DR. BULL, OF HEREFORD,

AND

THE OTHER MEMBERS

OF THE

WOOLHOPE NATURAL HISTORY SOCIETY,

I DEDICATE

THIS LITTLE VOLUME.

PREFACE.

IN this little volume my object has been to give a short Sketch of our British Insects, with the hope of inducing dwellers in the country to take an interest in these winged denizens of the air.

I believe the contents of the work will be found to be accurate. In the classification and divisions into families or groups I have adopted those which have the sanction of Entomologists eminent in their respective departments. The works of Westwood, Stainton, Rye, Shuckard, Staveley, Newman, Ormerod, Curtis, Lowne, Noël Humphreys, Duncan, Walker, Lubbock, F. Smith, Dallas, Douglas and Scott, etc., have been constantly before me and freely used.

After the Reader has acquired, as I trust he may be able to do, a general knowledge—a sort of bird's-eye view—of insect life as exhibited in the fields and lanes of this country, he cannot do better

than put this unpretending little volume on one side, and selecting some especial department in Entomology, pursue it with ardour, under the guidance of such excellent authorities as Westwood, or Rye, Stainton, McLachlan, or Ormerod.

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SKETCHES OF BRITISH INSECTS.

CHAPTER I.

INTRODUCTION.

ALL Animals may be included in one or other of the following great Divisions or Sub-Kingdoms, as they are termed:—I. VERTEBRATA, II. MOLLUSCA, III. ARTHROPODA, IV. VERMES, V. ECHINODERMATA, VI. CŒLENTERATA, VII. PROTOZOA. Insects, the subject of the present volume, belong to the Sub-Kingdom ARTHROPODA, *i.e.*, "having feet at the joints," from ἄρθρον "a joint," and πούς, ποδός, "a foot;" the term implying that the animals are possessed of *jointed appendages articulated to the body.* Not only insects, therefore, but the Myriapoda (centipedes), Arachnida (spiders, mites, scorpions), and Crustacea (lobsters, crabs, etc.,) belong to the Arthropoda, for in all these four *classes* we find jointed appendages articulated to the body. The Arthropoda are again divisible into two large natural groups according to their mode of respiration. In the Crustacea the respiration is aquatic, in the three other classes it is aërial; in the former it is carried on by means of special organs called *branchiæ*, or where no such organs exist by means of the whole

surface of the body; in the latter the respiration is effected by means of extremely beautiful and delicate air-tubes, which convey the oxygenating element to all parts of the body. The Sub-Kingdom Arthropoda may be represented in a tabular form thus :—

ARTHROPODA.

Divisions	Tracheata (breathing by tracheæ) (aërial)	Class 1. Insecta.
		Class 2. Myriapoda.
		Class 3. Arachnida.
	Branchiata (breathing by branchiæ) (aquatic)	Class 4. Crustacea.

At present we are only concerned with Class I., the Insecta, which it will be necessary to define, in order to distinguish it from the two other air-breathing classes of the same sub-kingdom. Insects are air-breathing animals having three well-marked divisions of the body, the head, thorax, and abdomen, always distinct one from the other; the thorax, or middle portion, is composed of three segments, the prothorax, to which is attached the first pair of legs, the mesothorax with the second pair of legs and first pair of wings, and the metathorax with the third pair of legs and the second pair of wings, where these last organs are present. The head always carries two antennæ. Insects are generally furnished with wings, and undergo a series of transformations (*metamorphosis*) before arriving at their adult

or reproductive form. Exceptional forms occur, but every insect must possess the following marks: "It must breathe air, and have its body cut into (*in-sected*, hence the name) three distinct parts, possess, as a rule, six legs and two antennæ;" if it be destitute of these characteristics the animal is not an insect properly so called.

But let us try to learn something more definitely of the structure of an insect by examining the various parts of its organization. At present we are concerned only with the adult form, or imago as it is called. If you take an insect, and after having killed it you examine it, you will notice that its body is composed of distinct rings and segments, of a consistency more or less horny, that these rings are joined to each other by a membranous skin, which serves to give flexibility to the whole. This outward integument is rendered more or less hard by a deposit of *chitine*, which extends from the exterior into the interior; in some insects, as in the horny wing-cases of beetles, this chitinous deposit is very thick, in others it is of softer texture, but is always sufficiently firm for the attachment of the muscles. Generally, thirteen rings or segments compose the body of an insect, there being one segment for the head, three for the thorax, and nine for the abdomen; but sometimes two or more are amalgamated together or concealed by others, so that fewer appear.

We will now examine in detail the head, thorax, and abdomen.

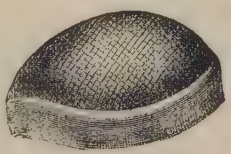
The head is formed of one single piece, and bears the antennæ, the eyes, and the various organs of the mouth; the antennæ vary much in form, sometimes they are

single filaments, sometimes furnished with bristles or hairs, which give them a comb-like or feather-like appearance; now they are thickened at the bottom, now at the top; now the last joints are formed of broad laminæ or plates; they are usually attached to the front of the head between the eyes. It is not definitely known what is the use of the antennæ, beyond the fact that they are organs of touch, but as such only play a subordinate part. It has been supposed by some that they are organs of hearing. From the researches of M. Lespés, Erichson, and Dr. J. B. Hicks, it would appear that the antennæ of insects are organs of hearing; it is said "they consist of a cell, sac, or cavity filled with fluid, closed in from the air by a membrane analogous to that which closes the foramen ovale in the higher animals; that this membrane is for the most part thin and delicate, but often projects above the surface, in either a hemispherical, conical, or canoe-shaped, or even hair-like form, or variously marked; that the antennal nerve gives off branches which come in contact with the inner wall of the sacs."* On the other hand it is asserted that the antennæ are partly organs of smell; on this point Mr. Lowne says, "I believe myself that this is the organ of smell, although I by no means consider the antennæ of all insects are necessarily olfactory organs. I think in many instances they are merely feelers. Perhaps the beautiful feather-like antennæ of male moths are sexual ornaments, although they may have special olfactory organs connected with them; and possibly the laminated

* Trans. Lin. Soc. Vol. xxii., pt. 4.

antennæ of many beetles, which consist of thin chitinous lamellæ, may be hygrometric, indicating the state of the atmosphere to the insect. I have little doubt, however, in other insects, as in the fly, especially when they are thick and club shaped, that they are olfactory or rather partly olfactory organs."* Some years ago I examined a great number of wasps, with a view to satisfy myself on this point; I used the bleaching process recommended by Dr. Hicks, but was unable to come to any conclusion on this interesting but puzzling point.

Conspicuous on the head of every insect are its two large compound eyes of various colours—emerald, blue, chesnut, orange, or as beads of burnished gold; besides these are generally to be seen two or three simple eyes, called ocelli, which are placed on the top of the head between the two large compound eyes—these require the aid of a lens to render them visible. The compound eyes are made up of an immense number of hexagonal or six-sided facets, which in some insects, as in the dragon-flies, can be distinguished by the naked eye; each facet is in itself a perfect eye, having a cornea, a lens, a pigment-coating, and a nervous filament; the eyes are immovable, and as the head is limited as to motion, it might be supposed that an insect was not particularly sharp sighted, but everyone who has tried to get at the blind side of a common house fly, knows how quickly



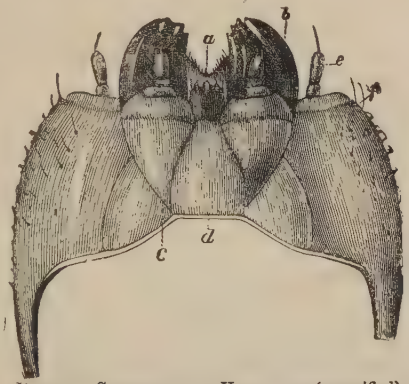
Compound Eye of an Insect

* The Anatomy of the Blow-fly, p. 32.

the darted hand is seen by the insect. The number of facettes varies, some insects having as many as 25,000, as in *Mordella*, a small kind of beetle, others upwards of 17,000, as in *Papilio*, a genus of butterflies, others 12,000, as in *Libellula* or dragon-fly; the house-fly has about 4,000, and the ant only 50 facettes; the simple eyes, *ocelli* or *stemmata*, as they are sometimes called, are generally three in number, and arranged on the forehead in a triangular form thus (.˙.); but they do not exist in all insects; they are nearly always black, round, and more or less convex. How far these ocelli differ functionally from or are supplemental to the large compound eyes, it is not possible to say with certainty; it has been suggested that they are intended for the perception of near objects, such as the various organs and pollen-producing parts of plants; as their refractive power is great, this is probable enough. These *ocelli* resemble those of the Arachnida, which do not possess compound eyes. All larvæ of insects which go through a complete metamorphosis possess only single eyes; the composite facetted organs are developed late on in the pupal stage.

The mouth is a very important and interesting point in the organization of an Insect; its structure is subject to almost infinite variety, though a common type underlies all the various forms, the same organs, however, being sometimes so modified in appearance, as to be with difficulty recognizable. Two chief types or plans are seen in insects, the masticatory and the suctorial, or the *Mandibulate* and *Haustellate* mouth; in the first the mouth is formed for prehension and biting, as in the *Coleoptera* or beetles; in the second

for suction, as in the *Lepidoptera* (butterflies and moths), *Rhyncota* (bugs and their allies), and *Diptera*, or two-winged insects, as flies and gnats. In the Mandibulate or biting insects the mouth consists of no less than six separate parts, viz., (1) a pair of horny curved jaws *(mandibles)* often furnished with strong sharp teeth;



MOUTH OF CATERPILLAR OF HAWK-MOTH (magnified). *a*, Upper lip. *b*, Mandibles. *c*, Maxillæ. *d*, Lower lip. *e*, Antennæ. *f*, Eyes.

(2) another pair of jaws *(maxillæ)* lying beneath the mandibles, generally made up of four parts, formed for chewing and conveying the bitten off pieces of food to the mouth; these organs generally bear one or two pairs of jointed appendages called *palpi*, "feelers;" (3) an upper lip or *labrum* attached to the lower part of the front of the head, and (4) a lower lip or *labium* with a single pair of palpi. All these parts are readily made out, and I would advise the reader to examine the mouth of almost any beetle, so as to see clearly for himself the several organs; all that is required is a pair of fine scissors, a lens, and a couple of strong needles set in wooden handles.

The *labium* is generally composed of two or more distinct parts, a basal portion called the chin or *mentum*,

and an anterior portion the *ligula*, commonly called, from its elongated form, "a tongue;" it is no true tongue, however, being merely an elongation of the labium; a real tongue forming the floor of the mouth, occurring but rarely in insect organization, as in the cricket.

Let us now examine the mouth of another insect; we will select the common Honey-bee. Here we see certain modifications of the organs; for while the mouth of the beetle is formed exclusively for biting, that of the bee is formed partly for biting and partly for suction. In this insect the labium and mandibles are nearly the same structurally and functionally as the corresponding parts of the beetle, but the maxillæ and labial palpi deviate considerably from the mandibulate type; the former are greatly elongated, and when closed form a sort of sheath, which incloses the tongue or *ligula;* the labial palpi too are greatly elongated and fold together, forming an inner sheath for the *ligula*, which is here a long tapering muscular organ with an immense number of short ring-shaped divisions covered with long hairs. This is the bee's honey-consuming organ, which may be often seen projecting a great distance when the insect is feeding, but which at other times is packed up and hidden beneath the maxillæ.

The bee's proboscis or tongue is solid, not tubular, as is sometimes imagined. "The manner," says Mr. Newport, "in which the honey is obtained when the organ is plunged into it at the bottom of a flower, is by 'lapping,' or a constant succession of short and quick extensions and contractions of the organ, which occasion the fluid to accummulate upon it and to ascend along

its upper surface until it reaches the orifice of the tube formed by the approximation of the maxillæ above, and of the labial palpi and this part of the ligula below."

We pass from the mouth of the bee and the *Hymenoptera* generally to that of the *Lepidoptera*, the Butterfly and Moth tribe, in which we find a complete adaptation for suction; the long spiral trunk of the butterfly is familiar to everyone. Here the labium and mandibles are quite rudimentary, being three small triangular-shaped plates difficult to make out, being concealed by the thick hairs which clothe butterflies heads; but the maxillæ are immensely elongated and are united along their inner surfaces, forming by the junction of the two grooves, which are channelled out along their inner surfaces, a long tube through which the insect sucks the juices of flowers. This proboscis or *haustellium* varies much in length; some lepidoptera require no food in their adult stage, and here the organ is small; but in the hawk moths, which gather the juices from flowers without alighting, the *haustellium* is sometimes two inches long. On the tips of butterflies' tongues are often to be found small conical shaped papillæ, which are supposed to be organs of taste.

Head of Sphinx-Moth (magnified).
a, Upper lip. *b*, Mandibles. *c*, Maxillæ. *d*, Lower lip. *e*, Antenna. *f*, Eye.

In the Bugs and their allies, which belong to the order *Rhyncota*, we have another form of suctorial mouth; here the labial palpi coalesce and form a jointed beak or *rostrum*, which is a tube split down the front, and enclosing two pairs of bristle-like organs, which are really greatly altered forms of the mandibles and maxillæ; by means of these sharp and fine needles the Rhyncota pierce the tissues of animals or plants, and feed on their juices.

In the Fly kind the ligula is developed into a broad fleshy organ or proboscis—whose form must be familiar to the most careless observer—through which the insect sucks up its food. In the *Diptera* generally, as in the common gnat, the labium consists of a long cylindrical organ with a round top at the extremity; along the upper surface of the labium runs a groove which sheathes the other organs of the mouth, viz., the mandibles, maxillæ, ligula, where it exists, and the labium; all of which are delicate cutting lancets, by means of which the insect pierces its victim and sucks out the juices. When you see this formidable array of miniature lancets and javelins, you will not wonder at the rapidity with which a gnat punctures your skin, and how immediately you feel the wound.

We now come to the second division of an Insect's body, which as we have seen consists of three parts, though from frequent amalgamation these segments are not always distinguishable; they constitute the thorax, and bear the organs of motion, almost always in insects six legs, and generally four wings; each leg is either firmly attached to, or articulated with the thorax by a quasi ball and socket joint, at the first joint, called the *coxa*

(hip), which is generally large and flat. The second joint is called the *trochanter*, a small joint which sometimes (as in the saw-flies, Tenthredinidæ) consists of two pieces; next comes the *femur* (thigh), the largest and thickest joint usually of an insect's leg, then comes the *tibia* (shank), about as long as the femur but not so thick, and lastly the *tarsus*, which consists of a series of small joints, varying in number from one to five terminating in a claw, often prettily toothed and accompanied by a pair of soft velvety cushion-like bodies, called *pulvilli*, very distinct in the house-fly. By means of these foot-pads the fly is able to walk on perfectly smooth surfaces in a reversed position. All sorts of opinions as to *how* the insect is able to maintain such a position, contrary to the laws of gravity, have been held; as that it was owing to the exhaustion of air from the foot-pads; or that the minute hairs, which clothe them, aided by the claws, take hold of small irregularities of the surface, and thus enable the possessor to retain an inverted position. According to Mr. Lowne, the last four tarsal joints are occupied by a sac, which secretes a viscid fluid, which flows into the pad and fills its cavity as well as the hollow hairs with which its under surface is covered. The footprints left upon glass by flies consist of small rows of dots corresponding to these hairs.

Of course there are all sorts of modifications, both in the legs and their component parts, according to the habits of insects; in the leaping insects, as grasshoppers, locusts, etc., the hinder pair of legs are much longer than the other two pairs, and the thigh or femur is very thick and powerful. Insects which swim in the

water have hind legs more or less flattened and fringed with long hairs, which they use as a boatman does his oar; forms of these oar-like feet may be seen in Dyticus, Notonecta, and Gyrinus. The mole cricket, like its mammalian namesake, has its fore legs very short and strong, the tibia being cut into finger-like projections suited to its burrowing habits; in the water scorpion *(Nepa cinerea)* the fore legs are converted into a pair of nippers, by means of which the insect seizes and retains hold of its prey.

The wings of an insect are beautiful and interesting objects; they are attached to the second and third segment of the thorax; each wing consists of two membranes with a number of veins or *nervures* between them, which ramify in various directions and help to keep the wings extended. Some insects have only two wings, others (the greater number) have four, which are either of a similar texture throughout, and are all available in flight, or else the anterior pair have a consistency like horn, and form a sheath or covering for the hinder wings when the insect is at rest; when in flight these wing-cases are kept still, being at right angles with the body. These are known by the name of *Elytra*, from the Greek ἔλυτρον "a cover" or "case," used for the shard of a beetle's wing as early as the time of Aristotle. All beetles (*Coleoptera*)—not the so-called "black beetles" of our kitchens, which are not beetles at all—possess these horny pair of wing covers, hence the term which has been given to the order, from κολεός "a sheath," and πτερόν "a wing." In some insects the basal part of the elytra is horny, the top part being membranous. The Diptera or

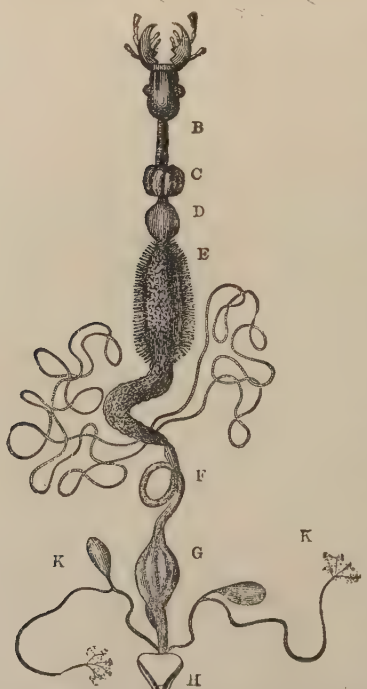
two-winged insects have a pair of small knob-like threads behind the anterior pair of wings; they have been termed *halteres* or balancers, and are generally regarded as the rudiments or representatives of the hind wings. Mr. Lowne is inclined to think that the function of these modifications of the posterior wings is auditory; he imagines he has discovered within them certain corpuscular bodies, which he considers to be otoconia. The membranous wings of butterflies and moths are covered with numerous flattened scales of various forms and exquisite beauty; hence the name of the order Lepidoptera from λεπίς a scale, and πτερόν wing; while those of many others are simply clothed with numerous small hairs.

The abdomen, as has been said before, consists of nine segments, but these are not always distinct; it is regarded as consisting of two portions, the abdomen proper, and the post-abdomen, the latter of which is supposed to be marked by indications of three segments between the generative outlet and the terminally situated anus. The abdomen proper never carries articulated appendages, with—so far as is known at present—the single exception of the *Spirachtha Eurymedusa*, a beetle, which carries a pair on the third, fourth, and fifth abdominal segments; the post-abdominal segments, however, frequently carry appendages, as the thick bristles of the cockroaches, the tubular appendages of the aphides, the forceps of the earwigs.

The organs of motion are localized in the thorax, the vegetative in the abdomen.

The accompanying woodcut will give the reader a

general idea of the digestive apparatus of an insect, the various organs of which, of course, differ according to the habits of the orders.



DIGESTIVE APPARATUS OF A BEETLE.

B, Œsophagus. C, Crop. D, Gizard. E, Stomach. F and G, Small and large intestine. H, Anus. I, Biliary vessels. K, Secretery organs.

The intestinal canal lies in the median line of the body, and runs from one extremity to the other; it is formed of three membranes, and commences behind the mouth in an œsophagus, terminating posteriorily in a widened cavity *(cloaca)*, which also receives the internal generative organs; the œsophagus leads into the first stomach or *crop*, from thence, in *mandibulate* insects, into a second stomach, which from its being supplied with horny plates to bruise the food has been called the *gizzard;* this leads into the true stomach, where the process of chylification takes place; the whole surface of this stomach is often plentifully supplied with glandular bodies called *villi*, which are supposed to secrete a gastric juice; a number of very

fine long convoluted threads or tubes surround the lower part of the chyle-forming stomach, and pour a biliary secretion into it; the small intestine follows this stomach, then the cœcum and the rectum. Near the end of the intestinal tract are often found other secreting organs which serve to elaborate certain fluids (as the poison of the bee and wasp), which various kinds of insects eject when disturbed, and which are often of an intensely disagreeable odour. The intestinal canal of insects varies considerably in length; as a rule, in carnivorous and suctorial kinds it is about twice the length of the body, in vegetable feeders it is very long, sometimes being equal to six or eight times the length of the body.

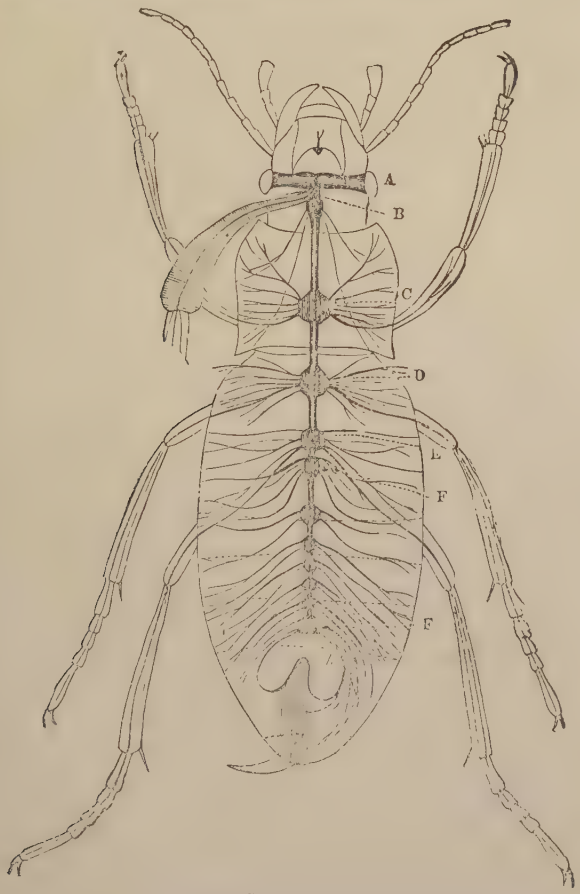
Circulation in insects is carried on by means of a long contractile tubular organ, which, from its position on the back is usually called the "dorsal vessel." This vessel represents the heart, which ordinarily consists of eight segments or sacs, which open one into the other from behind forwards, and which by contracting, drive the blood collected from the body and received into the heart by a series of valvular openings, forward to the region of the head where it escapes apparently, for no trace of arteries or veins have been discovered in insects. As the blood is on its passage through the viscera and other organs of the body, on its return to the heart, it becomes oxygenated by contact with the respiratory organs, which ramify in all directions through the body. These consist of an immense number of delicate tubes—the membranous coats of which are kept distended by minute spiral-formed filaments—which open out on each side of the insect's body. Through these

openings, a pair of which is usually to be seen on each side of the segments, excepting the head and the last segment of the abdomen, the air gains admission into the tracheal tubes. These openings, called *spiracles* or *stigmata*, are often beautiful microscopic objects, sometimes possessing valves which open and shut like the folding of a little door. The aquatic larvæ of many of the Orthoptera, Neuroptera, and Diptera, possess tracheæ which have no openings or spiracles; consequently, they do not receive the oxygen directly from the air, but from the water in which they live, in this way reminding us of the aquatic respiration of fishes. In a small *Ephemeral* insect *(Chloeon dimidiatum)*, the larva in its first three stages has no tracheæ developed, though subsequently it developes the tracheal gills.

The nervous system of an insect, in its most characteristic form, consists of a double cord which runs down the central portion of the body, and unites a series of nerve-knots or ganglia, as they are termed. Their normal number may be supposed to be eleven; three for the head and thorax, and eight for the abdomen; but in point of fact they often fall short of this number, some ganglia fusing with others, or becoming abortive. From each of these ganglia or nerve-centres various nerve filaments arise and are distributed to the various organs. A nervous mass placed above the œsophagus constitutes the insect's brain, from which the nerves of the eyes and the antennæ are given off. There is another nerve-mass just below the œsophagus, which unites with the brain-mass by a pair of nervous filaments, and forms the nerve-collar.

The sexes in insects are always distinct; there are no

hermaphrodites in the class, and sexual reproduction is the rule. The generative organs are varied in their ar-



Nervous System of an Insect.

A, Brain. B, C, D, E, F, Ganglia or Nerve knots with Nerve filaments.

rangement; the reproductive glands are symmetrical and double, the efferent ducts join a common duct before opening. The female sexual organs consist generally of the ovaries, oviduct, uterus, and vagina; but there is often a large number of accessory appendages, sometimes present, sometimes absent. Indeed it is seldom that all parts are present together, one or several being wanting. In neuter bees (barren or undeveloped females), the ovaries are deficient, though the evacuating ducts are constant. The females are usually larger than the males; this is strikingly the case where the females are wingless, the males winged; the antennæ and the tarsi often differ considerably in the sexes. Insects are generally oviparous, though some are ovo-viviparous. Various forms of agamogenesis, that is to say, production without the union of the sexes, have been observed amongst insects. Females with a reproductive apparatus provided with a receptaculum seminis may produce either embryos, as *Lecanium hesperidum* and *Chermes abietis* amongst the Coccina, or ova as *Psyche helix*, *Solenobia lichenella*, and *S. triquetrella* amongst the Lepidoptera; or they may produce wingless queen bees and winged queens as amongst *Hymenoptera*. In this class of cases sexual may alternate with asexual production, and it is most curious to observe that all male bees are produced from unfertilized eggs, while only the fertilized bee-egg will develop into a female or a perfect queen. Again, females with reproductive apparatus more or less imperfect, may produce either eggs, as happens with the "workers" or *neuters* amongst bees, whose produce is probably always males, or they may produce embryos as is the case with the Aphides, in

which certain generations are viviparous without any sexual process.* It has been said that insects as a rule are oviparous though they may be viviparous. Sometimes the larva is so far developed within the maternal oviduct, as to be almost ready to enter on its second or pupal existence on its appearance into the world.

Insects, as a rule, in their development from the egg, undergo, as is well known, a series of changes called metamorphosis; this is sometimes very complete or incomplete, and sometimes there is no change of form. As instances of complete metamorphosis I may mention butterflies, moths, and beetles, which go through three distinct stages called the *larva*, *pupa*, and *imago*, or perfect state. In the first stage the insect is like a grub, either provided with legs or destitute of those organs; in common language we call them caterpillars, maggots, or grubs; during this period eating is the order of the day, and this they do generally very voraciously, and in many cases most injuriously to the cultivated products of the soil. After repeatedly changing the skin to allow of the creature's growth, for the skin does not grow with the body, it assumes the *pupa*, or as it is usually called amongst butterflies and moths, the *chrysalis* stage. Here is perfect quiescence, the creature neither moves nor eats; there is death-like repose for a period, more or less long, according to the species. But though externally no change is visible, a wonderful drama is being acted "behind the scenes," and in due time that which entered the pupa state a grovelling grub emerges from it a beautiful winged

* See Rolleston's "Forms of Animal Life." cxii.

insect, gorgeous in colouring, graceful in form, and endued with high powers of rapid flight. The insect is now in its *imago* or perfect state; with the exuviation of the pupa-integument it has cast off all the vestiges of the organs characteristic of the larva stage, and assumed true legs, wings, compound eyes, antennæ, a more perfect nervous system, and most wondrous, perhaps of all, the biting jaws of the injurious caterpillar have been metamorphosed into the delicate spiral "tongue" of the nectar-sipping butterfly! Not, however, immediately on emerging from the pupa-case is the perfect insect ready to beat the air with its wings and to fly where it listeth, for at first the wings are soft and crumpled, hanging loosely at the sides of the body, but after exposure for some little time to the air, and when the tracheal system has by inspiration and expiration become fitted for aërial flight, the insect sails away, and its wings, now possessing the necessary stiffness for organs of impulsion in the air, are henceforth the creature's chief instruments as means of locomotion. In cases of such a complete metamorphosis as these, there is a wonderful dissimilarity between the larva and the imago, and insects undergoing the three distinct changes of larva, pupa and imago, are called "Holometabolous."*

But though complete metamorphosis obtains in the majority of the Insect class, there are many kinds in which the changes are partial and incomplete. In these cases of semi-metamorphosis the larva bears some resemblance, more or less exact to the perfect insect, the

* *i.e.*, undergoing complete change, from ὅλος "whole," and μεταβολή "change."

pupa is seldom wholly quiescent, and is generally active. The pupa possesses well-marked foreshadowings of the imago's true wings, in the form of small lobes or processes on its back; and in some an organ which the larva possessed—as for instance, the curious prehensile mask of the different members of the Dragon-fly family *(Libellulidæ)*—is discarded by the perfect insect. Entomologists, therefore, in accordance with this partial and incomplete metamorphosis, have given to those insects which exhibit it the name of "Hemimetabolous."* Again, there are insects in which the larvæ differ very little, indeed, from the perfect insects, where there is no metamorphosis properly so called. The perfect imago is often as wingless as the creeping larva, and the latter differs from the former stage, either in point of size, in the number of joints in the antennæ, and in the immature state of the reproductive organs. Sometimes the adult is rendered not quite so like the larva by the addition of a pair of wings, in which case the thorax and the abdominal segments are more distinctly divided than in insects whose imago is wingless. This kind of metamorphosis obtains (1) in Lice *(Anoplura)*, Bird-lice *(Mallophaga)*, and Spring-tails *(Thysanura)*, where the imago is wingless, and (2) in some of the *Orthoptera* and *Hemiptera* where the adult is endowed with wings. From the almost entire absence of metamorphosis in such cases, the insects are called "Ametabolous."†

The metamorphosis of insects is no doubt a very striking and remarkable phenomenon in their history,

* From ἡμι (ἥμισυ "half") and μεταβολή.
† From ἀ not, and μεταβολή.

but it must not be forgotten that there are many other animals which exhibit equally, if not still more wonderful spectacles.

Insects are divided into different Orders, from characters derived principally from the structure of the wings and mouth.

CHAPTER II.

ORDERS OF INSECTS.

THE following are the Orders usually adopted by Entomologists:—(1) RHYNCOTA, (2) ORTHOPTERA, (3) NEUROPTERA, (4) LEPIDOPTERA, (5) DIPTERA, (6) HYMENOPTERA, (7) COLEOPTERA. The first-named Order derives its name from characters belonging to the mouth (ῥύγχος, "a snout" or "beak"); the remaining five from characters belonging to the wings.

Although, as a general rule, all insects will fall naturally into one or other of these great Orders, there are some whose position is more or less problematical. Those curious little creatures that you may often see under stones and dead leaves, hopping actively to get out of the way, the Spring-tails (*Podurida*) and their allies, the Silver-scales (*Lepismidæ*), have been by some regarded as forming an order by themselves—the *Thysanura;* but Sir John Lubbock, who has for many years studied these little creatures, does not regard them in the strictest sense as true insects. The minute parasites on different birds—familiar to all who have carried partridges in their pockets—called Bird-lice, are evidently allied to the true lice, parasites upon mammiferous animals, in their general structure, but

while these latter have a suctorial mouth, that of the Bird-lice is formed for biting, consequently the true louse with its sharp retractile proboscis, will come under the Order Rhyncota, from which the other is excluded on account of the structure of its mouth; so difficult a matter it often is to form a classification that shall include and exclude all that is required. But notwithstanding the difference between the mouths of the true lice and the bird-lice, the general similarity of the whole structure of the animals will authorize us to place them both in the division of the Rhyncota.

The Spring-tails (*Poduridæ*) and Silver-scales (*Lepismidæ*), first grouped together by Latreille under the name of THYSANURA, from the fringed tails of some of the species, have lately been formed into two distinct orders by Sir John Lubbock, under the names of *Collembola* and *Thysanura*, in his valuable "Monograph for the Ray Society." They frequent dark places, but while the former, for the most part, prefer moist situations, and can endure great cold—I have seen numbers on ice under stones on the Swiss glaciers—the latter like dry walls and warm rooms. In the Collembola there is a remarkable organ underneath the abdomen, called the ventral tube or sucker, whose function is to enable the creature to adhere to surfaces by the emission of some viscous fluid. From this Sir John Lubbock has proposed the name of the order.* In most of the Collembola the tail, which is forked, is bent under the body, forming a jumping organ, by its sudden extension; in some species there is no saltatory organ.

* From κολλή "glue," and ἔμβολος "a peg."

These little creatures are in several genera covered with scales of various forms and sizes, generally colourless, but sometimes beautifully iridescent, as in the genus *Lepidocyrtus*. These scales are favourite microscopic objects. Besides scales, hairs of various forms clothe the bodies of these little insects. The young are hatched apparently within a period of from six to ten days, the larvæ are white and very active in their movements; I have seen hundreds of them under rotten bark in damp places. The Collembola undergo no metamorphosis. The young differ from the adults merely in being shorter and thicker, and having the spring-tail less developed; after moulting twice the white larval body becomes of the same colour as that of the adult, purplish and translucent.

Spring-tail (*Podura plumbea*).

Lepisma saccharina.

The Thysanura are much less numerously represented both in species and individuals than the Collembola; the body consists of the head, three thoracic and ten well-marked abdominal

segments. Two groups constitute this Order, viz. :—(1) The *Lepismidæ*, which are covered with scales, and (2) the two families of the *Iapygidæ* and *Nicoletiatæ*, which are covered with hairs only. One of the most familiar forms of the Thysanura is the pretty little *Lepisma saccharina* of a silvery white colour; it is not uncommon in kitchens and pantries in old houses. It runs with great activity, and has an elongated body about one-third of an inch long; it has no saltatory organ. Another species of Thysanura, the *Machilis maritima*, about half-an-inch in length, is very common on the rocky shores of this country; I have met with it abundantly in different places on the coast; it is brown mottled with bronze reflections. This species possesses a jumping spring-tail.

The study of those insects has been much neglected, and for long there has been no guide for the student; what had been written on their history and structure being scattered about in several publications, often procurable with difficulty; but the publication of Sir John Lubbock's "Monograph" will render their study both pleasant and easy.

The Order Rhyncota includes all those insects with an imperfect metamorphosis that possess a suctorial mouth, which consists of a jointed rostrum or beak, formed by the union of the labial palpi; it is tubular, and contains four bristle-like bodies, which are modified representations of the mandibles and maxillæ. By means of these sharp needles the insect pierces the skin of plants and animals and sucks up the juices. A great number of members of this order have four wings, variable in structure. Some are aquatic and live

entirely in the water, but the majority are aërial. The Order is divided into three sub-orders, viz. :—the *Anoplura*, the *Heteroptera*, and the *Homoptera*. The *Anoplura* contain all those insects commonly known as lice, which are parasitic on man and other animals. The suctorial louse (*pediculus*), of which four species are parasitic on man, belong to this sub-order ; it also includes all the biting bird-lice, which by some writers have been made into a separate order under the name of *Mallophaga*. But it is better to arrange the bird-lice, notwithstanding the difference of structure in the mouth, with the Anoplura. Nearly 500 different forms of these parasitic insects, formed on the plan of the common louse, have been described. Almost every bird has its parasite accompaniments, and several of the Mammalia have theirs. Some animals have only one species of parasite peculiar to itself, others have several species ; on domestic cattle three species are found, on the horse two, on the ass three ; on the golden eagle four, on the white-tailed eagle no less than six species of parasitic louse occurs, and water birds are as subject to them as land birds. These biting-lice do not suck the blood like the common pediculus, but eat the delicate parts of the feathers or hair. The Anoplura undergo no metamorphosis ; the eggs are hatched in a few days, and the young are soon capable of reproduction, hence the enormously rapid increase where strict measures are not adopted for their extermination. I believe it was Leeuwenhoek who computed that in two months two female lice could produce ten thousand !

The *Heteroptera* include those insects of the Order Rhyncota, whose anterior wings are heterogeneous, *i.e.*,

not of the same consistency throughout; from the base to the middle or beyond, the wings are more or less of a horny consistence, while the remaining portion of the wing is thin and membranous, the line of demarcation being distinct. In the Heteroptera the beak or rostrum springs from the front of the head. This sub-order contains two sections, the HYDROCORISA and the AUROCORISA; the former, as the name implies, contains the Water-bugs, and the latter the Land-bugs. In the HYDROCORISA there are two families, the *Notonectidæ* and the *Nepidæ*. As illustrations of these two families figures will be seen in Plate I. Fig. 10 is the Water Boatman (*Notonecta glauca*), a common insect in pools and canals. Its body is shaped like a boat, the keel of which is the back on which it floats and rows itself about by means of its long hind legs, which are delicately fringed with hair, forming as it were the blade of the oar. You may often see the boatman floating with outstretched oars, back downwards, on the surface of the water waiting for any little fly or gnat that may approach too near, which he will be certain to seize with his fore legs and pierce with his rostrum; for boatman is eminently carnivorous in his diet, and possesses a sharp-pointed beak with cutting lancets, with which he will not hesitate to experimentalize on your finger if you give him a chance. I have often kept specimens in an aquarium, where they will become tame after a time, and take bits of meat off the tip of a camel's-hair pencil. But if you are rearing young fish of any sort from the egg, you must beware of the boatman, for though he is not black in colour he is in disposition, and you may apply to him the words of Horace :—

"Hic niger est, hunc tu Romane caveto."

Underneath the prettily-marked wing-cases of the boatman you may see, by examination, a pair of large hyaline wings which the possessor uses when so inclined. Though when sunning itself on the surface of the water, Notonecta generally lies on his back, he can swim equally well with the keel up, and first turns on one side then on another with great rapidity. The larva and pupa resemble the imago, except that the former has not a vestige of wings, and the latter has rudimentary ones. The boatman's length is from 7 to 8 lines. There are other genera allied to *Notonecta*, as *Plea*, *Corixa*, *Cymatia*, and *Sigara*, all of which are good swimmers. Of *Plea* there is only one British species, viz., *P. minutissima*, which is not much above a line in length; it is common in stagnant waters. Of the other genera, *Corixa Geoffroyi*, about 5 lines long, is extremely common in stagnant waters; its form must be more or less familiar to every one who has stood on a bank and watched the fishing-net hauled in, when hundreds of these little smoky-black insects are jumping about in every direction, as not knowing what has happened to them. To the right of the boatman will be seen a curious scorpion-like creature (Fig. 11) with its fore-legs extended pincer-like, in a threatening attitude; this is the *Nepa Cinerea* or Water-Scorpion, which I have taken to illustrate the family of *Nepidæ*. This insect is a dull dingy-looking creature with a small pointed head, scorpion-like fore-legs, and a tail with two long bristle-like projections; it is nearly an inch long, not including the tail. It is painfully sluggish in its movements, and on watching it one is impatiently prompted to say with the policeman, "Move on—Move

on." It is very common in ditches and ponds, where it crawls slowly in the mud. It is of a long oval-shape and thin, looking like a decayed leaf more than an animal. *Nepa* is as black as he is painted, being a ravenous destroyer of various larvæ of other insects, which he seizes with his nippers, when he has stealthily succeeded in getting sufficiently near his victim ; but he seems so flat, one can hardly guess where he has room to stow away much food ! But it must be remembered that Nepa, like the Rhyncota generally, only sucks the juices of his victims, and does not consume their carcases. But though he looks so grimy outside, if you will open his wing-covers you will see the upper part of the abdomen is prettily marked with a bright brick-red colour. The bristle-like filaments are perfectly harmless instruments, in no way resembling a sting in function ; the insects extend them out of the water, and the air is by them conducted to the spiracles and tracheæ. The Water-Scorpions' eggs are of singular form ; they are oval and encircled at the base with seven long filaments which bend backwards ; when in the oviduct they seem to form a kind of a cup for the reception of the succeeding egg ; these eggs have appropriately been compared to little shuttle-cocks with recurved feathers. I have often found them in the ditches in the Weald Moors here where the Water-Scorpion is exceedingly common. There is no metamorphosis in the Nepidæ ; the young larvæ being like their parents, except that the tail filaments are represented in the larvæ by a single short point. Nepa, like the rest of the family, can leave the water and take to flight, but I have never seen it on the wing. There

are two other genera which belong to this family, viz. : *Naucoris* and *Ranatra*, both of which genera are represented by a single British species, the *N. cimicoides*, which has very thick pincer-like fore-legs, and is an excellent swimmer; and the *R. linearis*, a long stick-like cylindrical creature, 18 lines long exclusive of its spiracular tail filaments, which are alone 15 lines long; it has long nipper-like feet with habits similar to the Water-Scorpion.

The second section (AUROCORISA) contains several families, but I shall only take a short notice of the *Hydrometridæ* or Water-Measurers, *Cimicidæ*, the Bed-bug family, the *Reduviidæ*, and the *Lygæidæ*. Every one who has wandered by a stream or river, or loitered on the bank of a pool, must be acquainted with the forms of certain long and lanky creatures of a dark colour with slender legs, with which they skim or skate along the surface of the water. These are Water-Measurers (*Hydrometræ*), a very appropriate term, for they take four or five quick steps and then stop, then on again and stop. There are four or five species, of which the commonest, perhaps, is *H. Gibbifera* and *H. lacustris*; they are generally about $4\frac{1}{2}$ to $5\frac{1}{2}$ lines in length; they feed on small insects that may happen to come in their way, which they catch with their prehensile fore-legs. In many, if not most individuals the wings are imperfectly developed, in fact, they are often altogether absent—but these apterous individuals are as capable of reproduction as the winged. The underside of the bodies of the Hydrometra are often clothed with a fine coating of plush, which serves to repel the action of the water and to facilitate locomotion. A smaller

allied genus, *Velia*, is more prettily marked than the preceding one, having orange, white, and black spots. The only British species, *V. currens*, about 3 lines in length, is very common on clear streams, associating in companies; the winged form is rare. I must not forget to mention the long thread-like form of *Limnobates stagnorum;* it is about 5 lines long, and common in ponds covered with duckweed (Lemna), and sluggish in its movements. Fig. 9 is *Hydrometra lacustris.*

Of the *Cimicidæ* or Bed-bug family there is but one genus, and that, considering the unpleasant feelings associated with the insect's name, is one too many. These insects are flat, more or less round, legs rather slender and tolerably long; there is a mere indication of wings in a pair of short scale-like appendages; that they have a sharp proboscis can be attested by many a sleepless victim. The introduction of the Bed-bug (*Cimex lectularius*) into this country has been a subject of discussion. The obnoxious creature appears to have been known to the ancient Greeks and Romans, by the names of κόρις and cimex. Bacchus, in "Aristophanes's Comedy of the Frogs," before his expedition into Hades, to bring Euripides back to the upper world, asks Hercules to recommend, amongst other things needful on his journey, the inns where there were fewest bugs:—

Πανδοκευτρίας ὅπου κόρεις ὀλίγιστοι.

(*Batr.* 114).

Westwood quotes Southall as stating that the bug's first introduction into London was after the Great Fire in 1666: "learned men united in thinking that they were imported with new deal timber, as the bugs were

naturally fond of turpentine woods." Westwood says it is certain that they swarm in the American timber employed in the construction of new houses, and states a belief that they feed on the sap of that wood. It is, however, certain that these insects were known in England before 1666, for Mouffet, in his "Theater of Insects" (Book ii., p. 1096-8), printed at London in 1658, has a long chapter on them. He calls them Wall-lice, and speaks of them having been known in the year 1503. Still it is probable that these pests were not very common so early as that year. It is curious to observe that, although Shakspeare mentions bugs five times, in each case "bug" does not denote the insect, but is synonymous with "bug-bear" or "hobgoblin." The application of the term to the bed pest must, therefore, have been subsequent to Shakpeare's time. The verse in Psalm xci. 5, now rendered "terror by night," probably referring to night attacks from enemies, is in Matthew's Bible given, "Thou shalt not be afraid of any bugs by night." The word Bug or Bogie means an object of terror, from the cry of "Bo!" or "Boo!" a person utters when with covered face he seeks to frighten children; it is applied to the insect in a secondary sense as an object of horror. The eggs of these creatures are, according to Westwood, for I do not know them myself, white and of an oval form, terminated by a cap which breaks off to let the young escape, which are white

PUPA OF REDUVIUS PERSONATUS COVERED WITH DUST.

and transparent, so that the blood can be seen in the little creature's body; they undergo no metamorphosis, though they differ from the adult, in having a broader head and shorter and thicker antennæ. They attain their full size in eleven weeks. Fumigation with brimstone, thoroughly done, is the best cleansing of rooms troubled with these pests. Of the *Reduviidæ*, I shall mention only the *Reduvius personatus*, "the masked" Fly-bug, so called from its habit, in its larval stage, of covering itself with dust, thus disguising its real self. It is said to be a devourer of its relative, the Bed-bug; if so, all honour to Reduvius!

THE SAME WITHOUT DUST COVERING.

The *Lygæidæ* are for the most part small insects, being often marked with red, black, and white spots. The family, like that of the *Coreidæ*, are distinguished by longitudinous veins in the membranous portion of the wings. *Lygæus equestris* is one of the most conspicuous species.

The HOMOPTERA, the other sub-order of the *Rhyncota*, contains those suctorial insects whose fore-wings, whether thickened or membranous, are of a similar consistency throughout. In the common little Frog-hopper (*Aphrophora spumaria*) we have an instance of thickened fore-wings homogeneous throughout, the hind wings being membranous throughout; in the *Aphides* or Plant-lice the two pairs of wings are membranous throughout. The sucking apparatus in the *Homoptera* springs from the base of the head, very far back near

the breast. Mr. Westwood divides this sub-order into three sections, according to the number of joints of the tarsi; those insects whose tarsi are three-jointed constitute the section *Trimera*, those with two-jointed tarsi the *Dimera*, those with one-jointed tarsi the *Monomera*.

Of the Trimera, the Cicada is an instance. There are many species of this family occurring in different parts of the world, but only one British representative, viz., the *Cicada Anglica* (see Plate I., Fig. 1). The Cicadidæ are the largest insects in the sub-order, some foreign species measuring as much as six and seven inches in expanse of wing. The English Cicada has been occasionally seen in great numbers in the New Forest; I do not know what other recorded habitats there are. The ovipositor of the Cicada is a remarkable instrument; it is made of two strong saw-like borers, which work in the grooves of a supporting plate and pierce the wood for the reception of the eggs, which are generally deposited in dead branches, from five to seven hundred in number. But these insects sometimes deposit their eggs in living branches from which the sap exudes; thus injuring the trees. Dr. Asa Fitch, a high American authority on all matters relating to insects, includes the *C. septemdecim* amongst the noxious insects. The species has received its specific name from its supposed periodic visitations every seventeen years. The opinion has been confirmed by Dr. Asa Fitch, who remarks that "the horde of each district probably preserves the interval of seventeen years for coming out in its winged state" (see Report i. and ii., p. 38). The *Cicada plebeia*, common in the South of Europe, is

probably the species more especially alluded to in the writings of the ancient Greeks and Romans, under the name of Τέττιξ and Cicada. The Athenians were particularly attached to the Cicadas, and wore golden images of them in their hair, considering them an emblem of their claim to be *αὐτόχθονε*, "of native stock," sprung as it were from the ground, like the Cicadæ larvæ, which after being hatched, descend into the ground in the form of six-footed little grubs, where they grow and are transformed into active pupæ. The male Cicada has long been celebrated for his music, for the production of which he possesses a peculiar apparatus, situated at the base of the abdomen beneath and consisting of a pair of stretched membranes, acted upon by powerful muscles. These organs or drums are protected from injury by two broad plates, which are really the dilated sides of the metasternum. The sound issues out of two holes beneath these plates in a manner, says Westwood, somewhat analogous to the action of a violin. The Cicada was known to the ancient Egyptians, and was figured on their sculptures. Horapollo says that when they wished to symbolize a mystic man, and one initiated in the sacred rites, they used to depict a Cicada, for he does not utter sounds through his mouth, but sings a sweet melody by means of his spine (*διὰ τῆς ῥάχεως*). The ancient opinion as to the quality of the music was divided. Hesiod admired their shrill monotonous chirping :—

> "When the green artichokes' ascending flowers ;
> When in the sultry season's toilsome hours
> Perch'd on a branch beneath his veiling wings,
> With shrill sweet note Cicada frequent sings."
>
> —(*Works and Days*, *l.* 810).

Homer speaks of "good orators" like the Cicadæ, which sitting on a tree in the woods send forth their delicate voice. Virgil—not in this instance, at all events—a copyist of Homer, writes :—

"Et cantu querulæ rumpent arbusta Cicadæ."

Hesiod alludes to the habit of this insect uttering his musical notes at the hottest part of the day :—

"'Twas in that season, when on some green bough
High perch'd, the dusky wing'd Cicada first
Shrill chants to man a summer note, his drink,
His balmy food, the vegetative dew.
The livelong day from early dawn he pours
His voice : what time the sun's exhaustive heat
Fierce drys the frame."

Mr. Tennyson represents both the Grasshopper and Cigala as silent in the heat of the day :—

"For now the noon-day quiet holds the hill,
The grasshopper is silent in the grass :
The lizard with his shadow on the stone
Rests like a shadow, and the Cigala sleeps."
—Œnone.

Xenarchus of Rhodes, a comic poet, finds one element of happiness in the Cicada's life, in the fact that the female is silent :—

"Happy the Cicadas' lives
Since they all have voiceless wives."

But probably Xenarchus was not very fortunate in his matrimonial alliance.

The *Fulgoridæ*, or Lanthorn-flies of hot countries, often of a large size and said to be luminous in some

cases, are represented in England by a number of small individuals of a dingy and unattractive appearance. They may be known by the position of the antennæ which are placed under the eyes. Fig. 6 is an enlarged drawing of the prettiest of all the Homopterous insects, the Scarlet and Black Hopper (*Cercopis sanquinolenta*); it is local and cannot be said to be very common anywhere. I find specimens occasionally in this neighbourhood sitting generally on fern leaves; it is a good hopper, but seldom flies. The Cuckoo-spit Hopper (*Aphrophora spumaria*) the larva and pupæ of which envelope themselves in a frothy secretion, is one of the same family, the *Cercopidæ*. Fig. 2 is a representation of another Frog-fly very much enlarged—the natural size being about 2 lines long—it is the *Eupteryx picta*, Fabr., and may be found sometimes in great abundance on potato leaves. It is allied to the common Frog-hopper, but the larva does not secrete froth.

The section *Dimera* contains three families; I have only space to notice the Aphidæ or Plant-lice, an excessively injurious family of Homopterous insects, which may be regarded in respect of the vegetable world as analogous to the animal parasites, the Anoplura, already noticed. Every agriculturist, every rose cultivator, every hop grower has too great reason to be well acquainted with these destructive pests. The species are extremely numerous, almost every plant having its own peculiar parasite; they attack the leaves, stems, shoots, and even the roots of plants, piercing with their sharp proboscis the cuticles and sucking the juices. They have many enemies, amongst which may be mentioned the Lady-bird Beetles, which both in the larval and

adult form devour numbers, the larvæ of the Lace-wing Fly (*Chrysopa vulgaris*)—but it is not common enough to be of much service—and the larva of the pretty two-winged *Syrphus*. But the combined effects of all these are not equal to those of some of the Hymenopterous Ichneumons, which often occurring in enormous quantities do eminent service in the destruction of Plant-lice. The turnip crops in many of the midland counties, including Shropshire, suffered fearfully in the year 1865 from the attacks of various insects. The effects of the destructive work of the Aphis in the months of August and September of that year, were most remarkable. Crops that had survived the turnip-beetle ("Fly") and the fat caterpillars of two moths, *Agrotis segetum* and *A. exclamationis*, were suddenly attacked by countless myriads of Aphis, chiefly of the species *A. brassicæ*. In a few days that which promised so well was hopelessly blighted; the leaves first curled and puckered inwards, then withered and died; the smell arising therefrom tainted the air far and wide with a peculiar offensive odour. Scarcely a green turnip field was to be seen for miles around; nothing but dead leaves, which in the distance, gave to the field rather the appearance of a brown fallow than a crop of Swedes. Towards the middle of October an avenging army of other insects came in myriads; the turnip fields swarmed with them, your clothes were covered with them. They were but tiny creatures, no larger than the Aphis, about $1\frac{1}{4}$ line in length and $2\frac{1}{3}$ in expanse of wing. The insect in question was the *Aphidius* (Trionyx) *rapæ* of Curtis, one of the *Ichneumonidæ*, whose office it is to pierce the bodies of the

Aphides with its sharp ovipositor and to lay therein an egg, which will soon turn into an Aphidius larva, feed on the bloated Aphis, live in its skin, change into a nympha and pupa, then into the winged insect, and eat its way out of the now dried and puffed-out skin of the Aphis. The reader may often observe on the under-side of currant leaves, for instance, certain dry light brown shining bodies amongst the live Aphides; let him look closely, their skins unmistakably once belonged to the Aphides, there are their legs, head, anal-tubes; but the aphis is quite motionless; there is a small round hole in the skin near the posterior extremity; through this back-door the parasite Aphidius has left his home.

The history of the Aphis is remarkable; fertile males and females alone are produced in the Spring from eggs laid the previous Autumn; these grow rapidly, but do not assume wings; they lay not eggs, but young fertile females, which repeat the same process, and so on again and again for nine generations. At length, when Autumn arrives, males as well as females make their appearance, and frequently, but not always, develop wings; the usual pairing takes place, the female lays her eggs, which in the Spring, as I have said, will produce fertile females only.

To the section MONOMERA belong scale insects, popularly known as Mealy-bugs and Bark-lice; there is only one family, the *Coccidæ*, so called from the "berry" like form of the female; the term "Mealy-bugs" alludes to the white cotton-like substance which envelops the young. To the horticulturist the Coccidæ are as great a pest as the Aphides to the farmer. In greenhouses and hothouses they do great damage.

Every stroller in his garden must be familiar with the "blight" covering whole branches of the apple trees with white down; inspection with a lens will reveal countless thousands of little Mealy-bugs in different stages of growth. The female represents a convex brown scale about the size of a small split pea in some species; she is a most curious and anomalous creature, and exhibits, as Westwood truly says, an instance of an annulose animal becoming more and more imperfect as it approaches the imago state; for the female Coccus has lost all trace of articulations in the body as well as of articulated limbs; there is no head, legs, or body-rings; many of the females in the typical groups being in fact "inert and fixed masses of animal matter, motionless, and apparently senseless," resembling vegetable galls more than insect life. The account of the habits of *Coccus aceris*, communicated to Mr. Westwood by the late Mr. Curtis, will show the habits of this family. The males make their appearance in the winged state in May, when pairing takes place. By the end of June the females have attained their full gravid size; and on lifting up their bodies, their whole interior, or the entire space between the under surface of the body and the bark of the tree is occupied by white flowery-like matter, in which the minute young are to be observed of the size of the smallest dot; the dead body of the parent forming a covering to the young. In this state they are hexapod, antenniferous, and furnished with two long anal setæ. By the end of July the young quit the body of the parent, and ascend to the extremity of the young branches; there they affix themselves by their rostrum, gradually increase in

size, and lose their anal setæ, as well as their former activity. In this state they remain throughout the winter, without any diversity of appearance indicative of the sexes; and it is not until the following April that this is first perceived by the further increased growth of the females, and by the males assuming the pupæ state, which is quiescent, with the limbs arranged upon the breast, the fore-legs being directed forwards, a peculiarity not occurring in any other insects (Westwood, Vol. ii., p. 446). The males have one pair of wings, which are nearly destitute of nerves; two long tail-filaments proceed from the posterior extremity like those of the genus *Baetis* in the *Ephemeridæ;* the mouth of the male Coccus is rudimentary, and incapable of mischief. The British species of *Coccidæ* are numerous, the *C. Aceris* of the sycamore is one of the most common.

The exotic Cocci have long been celebrated for the beautiful dyes they yield; the *Coccus cacti*, which may sometimes be seen in English hothouses, produces cochineal. This insect is originally a native of Mexico, but it has become naturalized in other countries. Lac, or shell-lac, used for making varnish, sealing-wax, and paints, as the lake of the water-colour artist, is produced by an Indian species of Coccus. The small narrow seed-like scales common on the rind of oranges are the remains of another kind of Coccus.

ORTHOPTERA.

Leaving the RHYNCOTA, we come to the ORTHOPTERA, the Insects constituting this Order having each a mouth formed for biting. The word *Orthoptera* (from *orthos*, "straight," and *pteron*, "a wing"), is applied to this order, because all the insects belonging to it are distinguished by their posterior wings, which are generally large and strongly reticulated, being longitudinally folded when at rest. The metamorphosis is incomplete, both larva and pupa being in this order, as in the preceding one, active, and resembling the perfect insect, except that the former has no wings, and the latter only rudiments. The abdomen often terminates in two bristle-like appendages forming an ovipositor. The insects belonging to this order often assume strange and grotesque forms, such as leaves and sticks, hence called "walking-leaves," and "walking-sticks," as the *Phyllium Siccifolium*, and the *Bacteria fragilis;* they occur principally in warm climates, very few being found in Europe. The Orthoptera are divided into two large sections, viz., the *Saltatorial* and the *Cursorial;* in the former the hind legs are always much lengthened and formed for leaping, as in crickets, grasshoppers, and locusts. In the latter the legs are formed for running, as in the cockroaches. The Saltatorial Orthoptera include three families, the Locustidæ, the Gryllidæ, and the Achetidæ. The destructive species of the first family is happily seldom seen in this country. The fearful ravages of these insect-pests in localities they visit are well-known.

The *Oedipoda Migratoria*, or migratory locust, is the species which sometimes visits Europe. In the year 1748 these insects visited Europe in immense multitudes. Charles XII. and his army, then in Bessarabia, were stopped in their course. It is said that the swarms were four hours passing over Breslau. Nor did England escape, for a swarm fell near Bristol and ravaged the country in the month of July of the same year. Here in Shropshire and Staffordshire they did great damage by eating the leaves of the apple trees and the oaks, which latter looked as bare as at Christmas. The rooks did good service in this case. Locusts have been seen in Yorkshire in 1845, 1846, and 1847; in 1846 near London, and in many parts of England, and even in Scotland. The *Acridium peregrinum* (see figure 5) of Arabia, Egypt, Mesopotamia, and Persia, which, together with the migratory locust, is, I believe, the species more especially alluded to in the Bible, occasionally visits the South of Europe, and a writer remarks upon the occurrence of this species in various parts of England in October, 1869. In the South of France much damage is frequently done by these pests, but in Asia and Africa, whence they chiefly abound, their armies are fearfully numerous. The Locustidæ have no visible ovipositor, and no sound-producing organ as drum and file, the chirping sounds being produced by rubbing the legs and wing-cases; their antennæ are short. The family is represented in England by the well-known grasshoppers, whose shrill chirping is so familiar to all wanderers in the meadows in hot summer weather.

The *Gryllidæ* have long antennæ, and a long ovipositor in the female; the wing-covers of the males are

often furnished with a tail-like spot, surrounded by ridge-like veins, the sound being produced by rubbing the wing-covers sharply over each other. The green Grasshopper (*Acrida viridissima*) is one of the largest British specimens of this family, being about two inches long and three and a half in expanse of wing. Though of a beautiful green colour when alive, the colour soon fades on the death of the insect. I must not forget to notice the elegant green grasshopper of the oak (*Meconema varia*). It is a smaller species than the last, and dwells on trees, and not on the ground. As the insect is of the same colour as the leaves, and difficult to detect, the only way to procure specimens is to beat or shake the leaves and catch the falling beauties. I have occasionally obtained specimens from the bark of oak trees. It is a lovely creature, and I must ask my readers to try and procure specimens in the summer and autumn. Of the Cricket family, the *Achetidæ*, there are two genera, the cricket (*Acheta*), and the mole cricket (*Gryllotalpa*). In the former genus there is the well-known "cricket on the hearth" (*A. domestica*), and the field crickets (*A. campestris* and *A. sylvestris*). The domestic cricket has extremely long and slender antennæ, the wings and wing-covers have a horizontal position; the wings are of large size, and when folded up they form a pair of long, slender processes, which often extend some way beyond the extremity of the body. The sound-producing apparatus is similar to that in the *Gryllidæ*. The common cricket, as is well-known, establishes itself in the neighbourhood of the fire-place, generally preferring the kitchen, where its monotonous chirp, chirp, may often be heard. In

warm sunny weather, however, crickets prefer the open air, and may be found within the crevices of garden walls and similar places. Crickets are said to have the good character of destroying their cursorial cousins, the cockroaches. I do not know how far this is correct. In places where they abound to such an extent as to be a perfect nuisance, it may be useful to know that they may be destroyed by placing phials half filled with beer or other liquid in their haunts. Into these they crowd till they are full. The cricket's chirp is by some looked upon as a good omen, foretelling cheerfulness and plenty. This notion is pretty general in England. Cowper, addressing the cricket "chirping on his kitchen hearth," alludes to this superstition:—

> "Wheresoe'er be thine abode,
> Always harbinger of good.'

In Charles Dickens' little tale this same notion is embodied: "It's sure to bring us good fortune, John! It always has been so. To have a cricket on the hearth is the luckiest thing in the world." Nevertheless, the cricket's chirp is sometimes supposed to forebode disaster and death. When Blonzelind expired, Gay says—

> "And shrilling crickets in the chimney cry'd."

Similarly, in the "Oedipus" of Dryden and Lee—

> "Owls, ravens, crickets, seem the watch of death!"

Gilbert White, of Selborne, says—"Crickets are the house-wife's barometer, foretelling her when it will rain, and are prognostics sometimes, she thinks, of ill or good luck; of the death of a near relative, or the approach of

an absent lover. By being the constant companion of her solitary hours, they naturally become the objects of her superstition." A large kind of cricket is eagerly sought after by children in Africa, who roast the insects and eat them. The eggs, contained in a kind of bag, are esteemed a great relish. The field-cricket is a sly creature, living in burrows, in sandy banks, and amongst stones. It is larger than the house species, but is not at all common.

MOLE-CRICKET.

That curious insect, the Mole-Cricket, belongs to this family. It is well-named, for both in structure and habits it resembles the mole : it is constantly burrowing,

and the insect's anterior pair of legs are converted into flat digging organs, having an outward direction similar to the hand of the mole. Where the mole-cricket (*Gryllotalpa vulgaris*) abounds, it causes much damage to the crops, but it is very local in its distribution. I have never seen or heard of one in Shropshire.

A short notice of the Cockroach and Earwig will conclude my sketch of the Orthoptera.

The Cockroach, one of the cursorial Orthoptera, is the so-called black-beetle of our houses—the well-known pest of our kitchens and pantries. Nocturnal in their habits, omnivorous as to diet, black as to colour and character, of a most unpleasant odour, which they communicate to objects which they have touched, cockroaches are universally regarded with aversion and disgust. The specific Latin name of *Blatta Orientalis* was given to this insect to indicate its original home, supposed by some to be India. In Gilbert White's time cockroaches do not appear to have been so common and well known as they are now, for he regards this insect as a new introduction into Selborne in 1790. He writes —"A neighbour complained to me that her house was overrun with a kind of black-beetle, or, as she expressed herself, with a kind of black-bob, which swarmed in her kitchen when they got up in the morning before day-break. Soon after this account, I observed an unusual insect in one of my dark chimney-closets, and find since that in the night time they swarm also in my kitchen. On examination I soon ascertained the species to be the blatta orientalis of Linnæus."

These insects have a remarkable mode of oviposition for the eggs are not discharged separately, but are col-

lected together in a mass, and deposited in a large horny case, nearly half the size of the abdomen of the female, more or less oval in form, and somewhat compressed—not unlike a small bean. Within these cases the eggs are ranged in two rows, separated by a partition running down the middle, while other partitions occurring transversely, form separate chambers for the separate eggs. The cockroach may occasionally be seen running about with the egg-case protruded from her body. The males have very small wings, in the females they are rudimentary. This species, as well as another, the *Blatta Americana*, is extremely common on board ships, and is most numerous in seaport towns. A very large species, the *Blatta gigantea*, occurs in the West Indies, where, from its knocking noise, it is called the drummer. This insect will attack persons when asleep, and will even eat the extremities of the dead.

Our native species of *Blattidæ* are out-of-door insects, and much smaller than the black knight of the kitchen. *B. Lapponica* has pale-brown wing-cases, semi-transparent, and prettily veined. It is said to be freely found in the New Forest.

Earwigs (*Forficula auricularia*) are by some naturalists placed in a different Order ; they constitute the Dermaptera of Leach, and the Euplexoptera of Westwood. This latter term ("beautifully folded") refers to the structure of the wings—a striking characteristic of these insects—whose nervures radiate in a peculiar manner. The wings are of delicate texture, and fold up into the shape of a closed fan. The tail-forceps appears to be useful in helping the insect to pack or tuck up the wings under the wing-covers—a task which, considering the very

small size of the latter, it would not otherwise be able to do securely. The forceps is also an instrument of offence and defence. The earwig has been seen to seize a small beetle with its forceps, and carry it off in spite of its efforts to free itself. Earwigs seldom make use of their wings except at night.

These insects show remarkable attachment to their eggs and young ones. De Geer noticed a female earwig brooding over a number of eggs with the greatest care, and on another occasion he saw one accompanied by a numerous brood of newly hatched young, which crowded beneath her like chickens under a hen. This fact has since been corroborated by Spence and other entomologists. The young or larvæ, are like the perfect insect, except that they have no wings, and the forceps is not well-developed, not having the characteristic curve. They are at first quite of a pale colour, and active, and have the bad character of sometimes devouring the dead body of their mother

Earwigs are popularly supposed to enter the ears of persons sleeping in the open air, and reaching the brain, causing death. Extremely foolish as the fancy is, it has been so widely-spread as to give a name to this insect in many European languages. Some writers have derived the English name earwig from ear-wing, of which it is thought to be a corruption, in allusion to the shape of the insect's wing, but that this is incorrect is evident from the name in other countries. It is the *perce-oreille* of the French ; the *ohren-höhler* or *ohr-wurm*, of the Germans ; the *ör-matk* (*matk* being "a worm,") of the Swedes. Our word means an *ear worm*, the latter part of the word being from the Anglo-Saxon *wigga*, "a worm," or "creeping thing."

NEUROPTERA.

Earwigs are especially hated by gardeners, whose carnations and dahlias they are fond of nibbling. Earwig traps may be made by taking a number of hollow tubes, five or six inches long, and about half an inch in diameter, such as old specimens of the bamboo-cane, elder branches, or cow-parsley stems, and plugging up the top end, the tube being hung with open end downwards. It is the nature of earwigs to crawl for shelter into any little snug recess, and these tubes are tempting decoys for them. There are other kinds of British earwigs, one genus of which (*Apterygia*) is wingless, though the elytra, or wing-cases, are present. All these are of a small size. A very large but rare species, the Giant Earwig (*Labidura gigantea*) has sometimes been found here and there on our coasts, but "to the great grief of naturalists, and to the great honour of Providence," as some one remarked, it is very rarely found.

NEUROPTERA.

We now come to an Order of Insects, many extremely beautiful, and none in any way injurious to the crops of the garden and farm. It is not too much to say that there is not a single British species in this order that is at all injurious to vegetation. True, the larva of the large Dragon-flies may destroy the young fry of the trout now and then, but with this exception these insects do no harm. On the contrary, some of these insects are productive of much good by destroying and eating numerous other smaller insects hurtful to the garden or farm.

This order derives its name from two Greek words, one meaning "a nerve," the other "a wing," and is applied to these insects whose wings are divided by a great quantity of nervures into a greater number of spaces (*areolæ*) than is seen in any other of the orders. The beautiful Dragon-flies, the May-flies or yellow and grey drakes of the Fly-fisher, the delicate Lace-winged-flies, the brown and white speckled Scorpion-fly, the sluggish Stone-fly, often in the season to be seen resting on stones, palings, or bridges near running streams, the Alder-fly, with wings of modest brown and strongly veined, covering the body with roof-like position ; these are some of the common examples of this order of insects, which may be seen in their seasons in the Spring, Summer, and Autumn.

The metamorphosis in the *Neuroptera* is more complete than in the *Orthoptera*, the larvæ and pupæ generally exhibiting less resemblance to the perfect insect than in that order, but the metamorphosis is variable in the groups composing the *Neuroptera*. In their habits and economy also there is great dissimilarity, but by far the greater part are carnivorous. In their larval condition their abodes are various, some larvæ reside in the water, others in damp mud and sand, some conceal themselves under a cloak of excrement, others live exposed on plants. Various proposals have been made for the classification of the Neuroptera. We will pass over these and consider the different families composing this order that are represented in our own country. Let us begin with the *Libellulidæ* or Dragon-fly tribe. Who has not many a time stopped in his walk to watch the bold and rapid flight of some of the

large kinds of these insects? Who has not often had his attention arrested, when wandering by the rippling stream with tapering rod and treacherous flies attached, a large insect of glossy green flits by, the sunshine glittering on his burnished body? And who has not admired? This is the demoiselle Dragon-fly (*Calopteryx virgo*), than which a more lovely object can scarcely be met with in the whole world of insect life. The body is nearly two inches long, very slender, now dark steel-blue, now emerald-green—you cannot tell which for more than a moment—for the glancing sunbeams now give one colour, now another, to the burnished surface; the wings are large and gauze-like, with a large dark spot on each. This is the male. His partner is grass-green in colour, the wings are of a rich gold, and there are no dark spots.

The *Libellulidæ* are generally divided into two large groups, the *Agrionides* and the *Libellulides;* in the former the head is set transversely to the body, giving it a hammer-like appearance, the eyes are wide apart, the wings when at rest meet back to back over the insect's body. In the latter, the head is large and globular, the eyes are immense and almost meet; the wings when at rest are always extended. To the *Agrionides* belong the genera *Calopteryx* and *Agrion;* to the *Libellulides*, the genera *Libellula, Æshna, Anax,* etc.

In Plate II., Fig. 2, will be seen a figure of an insect of the genus *Agrion;* it is the *A. minium* or vermilion-red Dragon-fly. Thousands of these delicate little insects, with abdomens not thicker than a darning needle, some blue tinted, others red or some other

colour, may be seen in the summer and autumn months, flying about near ponds, rivers, or canals, their little forms glittering in the sunshine they revel in, or alighting on the surface of water weeds to deposit their eggs to their stalks.*

Fig. 8 will be recognised by my readers as one of the largest of our Dragon-flies; it is the *Cordulegaster annulatus* of Entomologists; it is a fine and handsome species, and has its body marked with golden-yellow stripes.

Dragon-flies with flat and short bodies (*Libellula depressa*) may often be seen hawking in pursuit of flies and moths, upon which these insects feed; these are of a dull-blue and golden-brown colour. Most Dragon-flies have a dark mark on each wing near the tip; in *Calopteryx virgo* it is absent. This spot is called the *stigma*.

There is a popular belief in this country that Dragon-flies sting horses, hence these insects are called Horse-stingers; it is needless to observe that neither Dragon-flies nor any other Neuropterous insects possess a sting; nor can they bite through the tough skin of a horse. It is possible that these large and strong flying insects coming suddenly within a few feet of a nervous horse's head would startle and alarm him, leaving the impression on the part of the uninstructed in Entomological matters that the horse had been literally stung. Last year I

* I can corroborate Mr. Patterson's account to Prof. Westwood, that these female Agrions occasionally descend to a considerable depth below the surface. On one occasion I noticed one of these little Agrions walk quietly down the stem of a water weed to the depth of a foot; she then stopped; her motive was doubtless to attach her eggs.

received a specimen of that hornet-like insect, the *Sirex gigas*, from an acquaintance who sent it to me with the statement that it had attacked and stung the horses he was driving at the time. Probably the horse had been alarmed by the sudden appearance of the insects, which have, however, no power to harm.

In France, from their light and graceful motions, Dragon-flies, as we have seen, are called *Demoiselles ;* in Germany, from their water-birth, they have the name of *Wasser-jungfern*, "Water-virgins," or *Flor-flieger*, "Gauze-flies," in allusion to their net-work wings.

Libellula Larva and Insect emerging from Pupa.

Dragon-flies have a keen sight, and fly with amazing rapidity, now forwards, now backwards, now darting

sideways, now hovering hawk-like. Beautiful as are all the forms of the perfect insect, the larvæ of some of them are anything but prepossessing in appearance, while they are eminently blood-thirsty in their habits. The larvæ and nymphæ possess a very remarkable weapon in their lower lip. The lip is very long and furnished at the extremity with a pair of pincer-like organs; it is attached to the chin by a hinge. When the larva is quiet this apparatus rests against the under part of the head, forming a kind of mask. Should some small insect or other larva approach within distance, the mask is suddenly lifted from the face, the hinge opens in the middle so as to allow it to stretch to full length, and the prey is seized by the fangs; the arm folds up again and conveys the prey to the creature's mouth.

Very curious, too, is the mode in which this Dragon-fly larva respires. At the extremity of the abdomen there is a sort of tail with five horny pieces, which the larva can open and shut. These pieces cover a valve formed by three membranous plates; on expanding these pieces the valve is opened, when a quantity of water is admitted into the body; the water is brought in contact with a peculiar apparatus which communicates with the tracheæ, and serves for respiration; it is then forcibly discharged through the same orifice, and so great is the violence of the ejected stream that the creature is itself shot forward to a considerable distance. When the nympha is ready to undergo its transformation, it creeps up the stem of some water plant and rests there for a time; then the skin splits and the creature leaving the world of water appears as a perfect

insect, no longer a dirty, sluggish, grovelling, creeping thing, but an active and beautiful denizen of the air.

The *Perlidæ*, or Stone-flies of the Fly-fisher, is a family of small extent; there are only a few species of moderate size, and are distinguished by the posterior wings being much larger than the anterior. These insects are all aquatic; the eggs are deposited in the water; the larvæ are very like the perfect insect; they are to be found in great quantities under stones in rivers and ponds; they are sluggish in their movements, adhering closely to the sides of stones. One of the largest of the family is the Stone-fly of the angler, the *Perla bicaudata* (Fig. 6) it appears in April; another species known to fishermen in some parts as the "Yellow Sally," the *Chloroperla viridis*, makes its appearance in May. Respiration in the larvæ is carried on by means of gills attached sometimes to the thorax, sometimes to the abdomen. None of the British Perlidæ are distinguished for much beauty of colour, but some exotic kinds are richly tinted, such, for instance, as the *Eusthenia Spectalis* of Westwood, an Australian species, with pink and violet-tinted wings, of which insect M. Pictet's figure is before me as I write.

The *Ephemeridæ* or May-flies, so well known to the Fly-fisher, are distinguished by the small size of their hinder wings and their antennæ, by the absence of a true mouth—for the organs are in a very rudimentary condition—and by two or three long hair-like appendages at the end of the tail. The family consists of several genera; the best known species being the *Ephemera vulgata*, the yellow and grey drake of the angler. Some of the small kinds belonging to the

genera *Baëtis, Chloë,* and *Cœnis,* are exquisitely beautiful and delicate in form.

The genus *Ephemera* is characterized by the possession of three nearly equal hair-like appendages at the end of the tail; they are longer in the male insect, which is further distinguished by two curved clasping organs at the end of the abdomen. The May-fly deposits her eggs by little packets at a time, first in one place, now in another, in the water; they soon sink and become attached to submerged weeds and stones; soon they change into larvæ, very curious creatures indeed; in their larval stage they are believed to live for two or three years, during the whole period of which they are active eaters. I have found the intestinal canal of the larva to contain the spores of numerous algæ, small crustacea, rotifera, etc. Both larvæ and nymphæ are often found in holes in river banks, and frequently in the sand or mud at the bottom of the water. The only difference between larva and nympha is that the latter has sheaths for the wings, which are rolled or crumpled up inside. The banks of rivers may often be seen to be riddled by these larvæ, which tunnel for themselves tubular galleries in the mud to the depth of four and five inches. The larvæ of some other members of the May-fly family, instead of living in sand or in tubular galleries, swim from place to place, resting on the leaves and stems of water plants. The abdomen of the larva and nympha of *Ephemera vulgata* is bordered on either side by a row of gills, which, by their constant motion, serve to draw fresh currents of water to oxygenate the blood. Each gill consists of two large trachial trunks, in which small air vessels ramify in

all directions. In the imago state the whole respiratory organization is changed, the gills are cast aside, and the insect now breathes by means of stigmata.

The term "May-fly" is indefinite, standing for various kinds of insects in different counties. In Shropshire we restrict the word to the *E. vulgata*. It is quite an error to suppose that May-flies (*Ephemeridæ*) are produced from the stick-baits or caddis worms, so common in every stream and pond; these are the larvæ of the *Phryganidæ*, another family of Neuropterous insects. The terms *caddis, cadow, caddice*, are sometimes used to denote the May-fly. The derivation of the word is probably from the German *Köder*, "bait," these Ephemera nympha being abundantly consumed by trout and other fish just before assuming their winged state. Isaac Walton, however, appears to have held the erroneous notion that the May-flies were produced from the stick-bait; he says, "He loves the May-fly which is bred of the cod-worm or caddis, and these make the trout bold and lusty;" and Latham, in his "Large Dictionary," perpetuates the error, for under *Caddis*, he writes, "a kind of worm or grub (generally the larva of the May-fly), found under water in a case of straw."

Let the reader sit by the bank of a stream some sunny afternoon the last week in May or the first in June, and he will witness the birth of thousands of May-flies. On coming to the surface of the water the nympha wriggles and struggles vigorously; the skin of the back splits and out comes a winged insect which flutters and flounders about till, if spared by fish, it gains the bank, the empty nympha skin floating down

stream. This is the first winged condition of Ephemera; he is now in what is aptly termed his sub-imago state; his wings are scarcely dry, and his muscles are unequal to great exertion; he is a heavy clumsy flier, now he drops for a second or two on the water, then flops along helplessly; but by-and-bye he may gain the bank, where he will remain two or three hours perhaps, and then another change will take place. Look at this blade of grass; what is the shadowy form that clings lifelessly to it? It is a delicate membrane, thin and light as possible, which the slightest breath will blow away. Notice the split across the back. It is the cast-off skin of the Ephemera in its sub-imago state, now metamorphosed into a creature more active than harlequin or columbine—the male into a dark-brown insect with clear gauze-like wings, the female into a beautiful creature with body marbled white and brown. How different now is the mode of flight! No longer a clumsy helpless fluttering, but a swift strong flight, not unlike that of the Dragon-fly, is that of the perfect Ephemeral imago. Now high in the air, now sailing along close to the surface of the water, she ever and anon dips gently into it and leaves a few eggs therein. This is the sole object of her life now she has become a mother; not a particle of food has she tasted since she left her nymphal state and her deserted swaddling clothes to the mercy of the stream; nor will she take food so long as her short life lasts. If you examine the digestive apparatus of any of these insects, whether male or female, in the sub-imago or imago condition, you will never find the slightest traces of food in the stomach; this organ, as well as the whole intestinal

canal, is almost always full of air-bubbles; I catch one of those dancing males, which I recognize by his very long fore-legs, extended so that one might at first sight mistake them for antennæ; I press him quickly in the middle; crack he goes! for the air-bubbles have burst by the pressure. No wonder that Ephemera's stomach is empty, for, as a fact, he has no real mouth; there is no passage from the mouth to the stomach. But though the stomach is full of air, we must not suppose that Ephemera suffers at all from flatulence. The air in the intestinal canal, there can be no doubt, serves the purpose of a balloon and helps to buoy the insect up, and saves the expenditure of muscular force; for as no food is taken to supply the waste, the muscles are not capable of long-sustained action.

The peculiar up-and-down flight of the May-flies must be familiar to everyone. In groups they love to practice their up-and-down flight; with head erect and bodies prettily curving upwards they exercise their characteristic dance, especially when the sun shines brightly and the air is still. But I must here notice that it is the males that exercise this particular style of dance, rising up sometimes ten or twelve feet, then dropping down again suddenly the same distance; at least I think this dance, as a rule, is strictly confined to the gentlemen, for I have never detected a lady May-fly in her marbled dress of white and brown amongst the company.

I should mention that the "Green-drake" of the Fly-fisher is the sub-imago stage of the May-fly, while the "Grey-drake" is the perfect imago female. It is in their sub-imago state that so many thousands fall

victims to the voracity of the hungry trout or other finny inhabitant of the rippling stream or lake (Fig. 1).

The term *Ephemera*, so applicable to this creature of a day, is as old as the time of Aristotle, who speaks of certain insects which live and fly about till evening and die at sunset. The life of the May-fly is pre-eminently a short one, and though specimens have been kept alive for some days, the word correctly enough describes the shortness of its existence in its insect stage. Though these insects sometimes occur in England in enormous multitudes, the numbers are vastly exceeded in Switzerland and other countries. I have somewhere read that these insects are so plentiful that they have been collected and used to feed pigs!

On Plate II., Fig. 5, the reader will see a drawing of the Lace-wing-fly (*Chrysopa vulgaris*), a representation of the family of *Hemerobiidæ*. It is not easy to imagine anything more beautiful and delicate than the Lace-wing-fly, with its eyes of burnished gold, its wide gauze-like wings, reflecting varying hues of pink or green, according to the incidence of the angle of light. The larvæ of these insects are to be enumerated amongst the farmers' friends, inasmuch as they are great devourers of the Aphides or Plant-lice. Very curious are the eggs of the Lace-wing-fly; they are laid in small bunches upon leaves. Each egg is supported at the end of a long thread or footstalk about half an inch long. The mode in which this insect deposits her eggs is as follows: she bends down her tail and presses it against a leaf, upon which she places a small drop of viscous matter secreted by herself, quickly she raises her tail and draws out a thread of this viscous matter, which

soons hardens on exposure to the air. By-and-by she affixes a small egg, which she fastens by another drop of the secreted fluid, to the extremity of the thread.

Beautiful in form, structure, and colour as the Lace-wing is, it generally has a most offensive odour, which it readily imparts to the hand that has hold of it, and which is more easily acquired than got rid of. The larva spins a small round cocoon, in which it developes its pupal and imago states. The *Hemerobiidæ* are allied to the *Myrmelionidæ* or Ant-lions, whose curious little larvæ, possessed of a formidable pair of jaws, excavate hollow pits in sandy places inhabited by them, in which they conceal themselves with the exception of the head and jaws, and lie in wait for prey; should an unlucky insect or larva slip into this sandy hole, the Ant-lion is soon down upon him and sucks his juices; should he attempt to beat a retreat by climbing the sides of the pit, the Ant-lion throws up showers of sand, and quickly brings him down.

The *Panorbidæ*, or Scorpion-flies, so called from a curious pincer-like appendage at the end of the tail, exactly like that of the scorpion, have also a peculiar head, which is prolonged below into a beak, at the end of which the mouth is situated. The most common British species and type of the family is *Panorba communis*, generally found in hedges (Plate II., Fig. 3). They are predaceous in their habits, feeding upon other insects, and probably are beneficial in this respect. The tail-forceps which the insect is fond of displaying in threatening attitudes, seems to say, "Noli me tangere" to the insect collector; it is, however, powerless to hurt. The other British genus, *Boreus*, contains only one species,

B. hyemalis, so called from appearing in the winter when "the cold north wind doth blow." This insect is of small size, with long legs and body, like the larva of the grasshopper; it is, I believe, not a common insect, but from its small size, and its living under moss and stones, and in snow, at such a season of the year when Entomologists are arranging their cabinets rather than collecting, it may be more frequently to be met with than is supposed.

The *Raphidiidæ* or Snake-flies, have their prothorax lengthened into a slender neck, terminated by a broad and flattened head. The female has a long ovipositor; and the whole appearance is certainly not inviting. A modern Entomologist once received a specimen of a Snake-fly (*Raphidia ophiopsis,* one of the largest British species), with an urgent request that he would give his opinion as to the probable extent of the injury which a baby, on whose face it was found, might have received. Though the insect is uninviting, it is harmless. The Snake-flies are predaceous, feeding on other insects; they are to be found near woods and streams.

The *Sialidæ,* a family consisting of a few species, is represented in this county by the well-known orl or Alder-fly of the angler. This is the *Sialis lutarius* of a brown colour, and with wings very strongly veined, and shelving into a kind of roof (Fig. 7). It is excessively common in spring and early summer, and numbers may readily be picked off the stems or leaves of plants on which they have settled, so sluggish are they in their movements. The female is larger and fatter than the male: she deposits her eggs on the leaves and stems of water plants. These clusters of eggs are very pretty objects; they are of a reddish

brown colour, cylindrical in shape, with a narrow point at the top; they are attached to the stems with the most precise regularity. I have often watched *Sialis lutarius* in the act of laying her eggs; firmly holding on by her legs to the stem or leaf of a plant, such as a *carex* or *sparganium*, she bends down her abdomen and glues egg after egg upon it in the regular manner described. In about ten days' time the young larvæ are hatched, when they drop into the water, where they pass their larval state. And certainly the larvæ are ugly, ferocious looking fellows, of a shining brown colour, a strong pair of jaws, which they exhibit in a menacing way when disturbed. The abdomen has a fringe of filaments on either side—seven pairs in all. These are the branchial organs, and serve both for respiration and locomotion. If a segment of the larva be cut off from the body, and placed with its attached filament under the microscope, one sees at first sight the function of these organs. The filament contains a delicate tracheal tube, with numerous arborescent branchlets, extending along its whole length; near the base it joins a large lateral tracheal vessel. When the creature wishes to assume its pupa state, it crawls into a hole in the bank and forms a cell. In this stage it is inactive.

The *Phryganidæ*, or Caddis-flies, are by many Entomologists separated from the Order *Neuroptera*, and placed in an order by themselves, on account of the structure of the wings, the anterior pair of which is covered with hairs, hence the term proposed for them, the *Trichoptera*. The wings have no cross reticulations, and the manner in which the hairs are fixed on the first pair of wings reminds one of the scales in the butterfly's

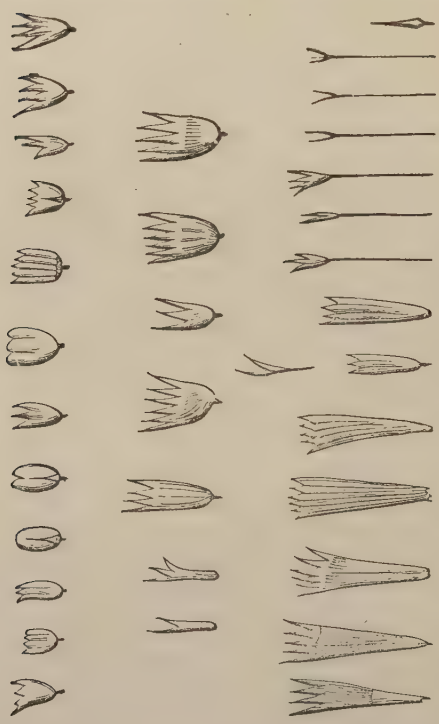
wing. The insects, of which there are a great many British species, are well-known, both in their larval and perfect states to all anglers. Various forms are to be seen near every river and pond, of different sizes, some about an inch in length, others almost microscopic in size. Most of them are tolerably active runners, but their flight is, for the most part, heavy. These insects are all aquatic, the larvæ forming for themselves little homes of dead sticks, stones, bits of grass, shells, grains of sand, etc., in which they dwell. Some are active, and carry their houses about with them ; others attach them firmly to stones and other submerged bodies. The bodies of the larvæ belonging to the larger species are thick and fat, and are favourite food for almost any kind of fish. The segments of the abdomen have white filaments, of various form, the external organs of respiration. The materials of these caddis' houses are united by fine silken threads, spun from a spinneret on the animal's labium. At the end of the tail there are two hook-like appendages, by means of which the larva adheres firmly to the inside of its dwelling. Most of the larvæ are herbivorous, though they will also eat other larvæ, and have been known to prey upon each other when in confinement. When the larva wishes to pass into the pupa state, it closes up the ends of the tube with a sort of open-work fence of silk, which admirably serves the double purpose of keeping out enemies—saying "not at home" to callers when the creature does not wish to be disturbed—and of allowing free access of water to the branchial appendages which, in the pupa, resemble those of the larva. When ready to complete its final change, the pupa bites away the silken grating, and sets itself free ; some

species crawl up the stems of water-plants, and undergo their change in the air; others swim to the surface of the water, and use their old pupal covering as a raft from which to rise into the air, after the manner of some gnats. Like the *Ephemeridæ*, the *Phryganidæ* have only rudimentary mouths, and as they never eat they are doubtless very short-lived. The females of some of the species have been seen to descend a foot deep or more into the water to deposit their eggs, just as we have seen is sometimes the case with some of the dragon-flies. The colours of all the British Phryganidæ are obscure, being brown, grey, or black.

LEPIDOPTERA

The *Phryganidæ*, a family of insects noticed in the last chapter, may be considered to form a sort of connecting link between the Orders *Neuroptera* and *Lepidoptera*, so similar are some of the species to moths. We come now, therefore, to the *Lepidoptera*, containing the Butterflies and Moths—insects which, from the delicacy of form of many species, and the brilliancy of the colours often displayed on the wings, have always been, perhaps, the most attractive of all insects. The structure of the mouth of a Lepidopterous insect will distinguish it from one belonging to any other of the Orders. The long tongue, spirally rolled when at rest, is an organ admirably suited for inserting in the deep petals of flowers and extracting therefrom the sweet

nectar. It is not a single, but a double tube, the two tubes adhering along the inner surfaces; on either side near the base are to be observed two large hairy labial palpi; the other portions of the mouth exist only in a rudimentary condition. The wings are four in number, generally clothed with small scales set close together and laid one over the other, like tiles or slates on the roof of a house.



Different forms of Scales of Lepidoptera.

From the presence of these scale-like hairs on the wings, the insects belonging to this order have received the name of Lepidoptera, from the Greek word *lepis*, "a scale," and *pteron*, "a wing." If these scales are brushed off, the membranous nature of the

wing is distinctly visible. The Lepidoptera have, as a rule, six legs, the normal number of all insects, but in some of the butterflies the fore legs are either wanting or rudimentary. The larvæ of the *Lepidoptera* are popularly termed caterpillars, of various forms and sizes. The body contains thirteen segments, the first of which forms a strong horny head, provided with biting jaws. On the labium there is a slender hollow body, which is in communication with two internal glands, whose function it is to secrete the substance out of which the silky threads are spun. This organ is called the spinneret, the value of which will be acknowledged when we consider its use in the production of the silk of commerce. Many of the Lepidoptera, beautiful as they are in their perfect state, are eminently destructive to the gardener and the farmer. Every one is familiar with the nasty green grub that riddles his cabbages and cauliflowers through and through. The enemies that do this are the larvæ of the "Garden White" butterflies, which, like the larvæ of most of the *Lepidoptera*, are voracious feeders. They grow rapidly, changing their skins frequently. In many species there are two broods every year; others, again, require two years or more before they assume the perfect state. In the pupa condition the creature is inactive: some enclose themselves in a silky cocoon, others select the lower surfaces of leaves, and roll themselves in, fastening their bodies by silken lines; others simply bury themselves in the earth, and may often be dug up in the form of dark brown cylindrical bodies of various sizes. When the insect first emerges its wings are soft and crumpled, as may be seen by all who have kept silk-worm moths. Fortunately

this order of insects, probably the most destructive of all, has numerous parasitic insect enemies, which lay their eggs in the bodies of the larvæ in which they are hatched, and on the juices of which they feed.

Butterflies and Moths constitute the Order *Lepidoptera*. But what is the difference between a butterfly and a moth? How shall we distinguish them? We shall see. A butterfly has always a pair of club-shaped antennæ; they are thickest at the tip. A moth has its antennæ of various forms, bristle-shaped, or plumose, very seldom indeed clubbed. This distinction has separated the Order into these two sections, the *Rhopalocera* (from *rhopalon*, "a club," and *keras*, "a horn,") and the *Heterocera* (from *heteros*, "different," and *keras*). The former contains the butterflies, the latter the moths. But there are other well-marked distinctions. In Butterflies the wings, when at rest, are carried upright, back to back. In Moths, as a rule, they are not so carried, they are generally laid down flat over the body. There is no rule, perhaps, without exceptions. Thus the currant moth, and a few of its allies, rests with its wings raised like those of a butterfly, but the antennæ here declare them to be moths. Again, there are butterflies, such as some of the family of Hesperidæ, which carry their fore-wings upright, and their hind-wings in a horizontal position when at rest. In the hind legs of butterflies there are two pairs of spurs on the tibiæ—excepting in the family of the *Hesperidæ*—which would almost seem to be a connecting link between butterflies and moths; the moths possess one pair of spurs only. All butterflies fly by day only, moths by night and day. The British species of the Butterfly section number

sixty-six; they are divided into five families. Of the Moths there are about two thousand species, and more than one hundred families, which consist of nine large groups.

The following are the five families into which the British butterflies are divided:—

1. Papilionidæ.
2. Nymphalidæ.
3. Erycinidæ.
4. Lycænidæ.
5. Hesperidæ.

The first family contains two sub-families, the *Papilionidæ* and the *Pieridæ*. In the first the inner margin of the hind wing is concave; in the other it is not so. Of the first sub-family only one species is known in this country, and that is the large, rare, and beautiful Swallow-tailed butterfly (*Papilio machaon*), so called from the prolonged margin of the hind wings. Its colour is yellow and black, with lines and spots, a deep bluish black band near the hind margin, a bright red round spot on the inner margin of each hind wing. I do not know this species except in cabinets. It is chiefly to be found in the fenny districts of Huntingdon and Cambridgeshire, though it has occasionally been captured in Sussex and Kent. The larva, which is of a bright pale green colour, with black bands and orange spots, feeds on the cow-parsley, marsh-parsley, and other umbelliferous plants. The perfect insect is said to be a high and rapid flyer, capable of soaring aloft. It emerges from its pupa the middle of May.

Perhaps one of the most charming of the second subfamily is the Sulphur or Brimstone butterfly (*Gonopteryx Rhamni*), which receives its generic name from the tips of the wings being sharply and prettily angled. The male insect is more brightly sulphur than the female. A small orange spot is to be seen near the centre of each wing. The specific name of the Rhamni is given to it because the larva feeds on the buckthorn.

The Brimstone is very common in Shropshire. It appears very early in the year, mild sunny days of March and even February tempting it to fly abroad. These early visitors are autumn-bred individuals which had hibernated. A drawing of the Brimstone butterfly will be seen on Plate III., Fig. 2.

The common Whites, so abundant everywhere, are the *Pieris brassica* (large white), the *P. rapæ* (small white), and the *P. Napi* (the green-veined white). The larvæ are more or less green or yellow with black spots, and feed on cabbage and other cruciferæ.

The large White is the most destructive to cabbages, and should always be destroyed, if possible. Children should be encouraged to catch them and crush them, and not blamed for killing the "poor little pretty butterflies." "Handsome is what handsome does," and the converse to this is, in the same sense, equally true, "Ugly is that ugly does." Fortunately, we have in nature a powerful destructive agent in the little Ichneumon fly, the *Microgaster glomeratus*, which lays its eggs within the body of the cabbage-eater, where they turn into small larvæ, which feed on the fat of their host, who, bad luck to him, goes on eating faster than ever. Retribution, however, must come in time, and when the cabbage-

eater should turn into a chrysalis, the parasitic guests are thinking of changing too, so they burst through the skin of their host, and leave him to perish.

In the *Nymphalidæ* the imago has only four legs fitted for walking, the first pair being rudimentary. This distinguishes the family from all others, with the single exception of the only species of the family of *Erycynidæ*, the *Nemeobius lucina*, the male of which has only four legs fitted for walking, though the female has the normal number of six. The Peacock, Red Admiral, Tortoiseshells, White Admiral, Purple Emperor, Painted Lady, Marbled White, Meadow Brown, Speckled Wood, &c., belong to this family. Many are brilliantly coloured, as the Admirals and Peacocks. The magnificent Red Admiral (*Vanessa Atalanta*), a drawing of which will be seen on Plate III., Fig. 1, is common everywhere. The perfect insect generally appears in August. The larva is of a yellowish grey colour, with a pale yellow lateral line, and the segment beset with hairs. It feeds on the common nettle, changing into a chrysalis in the summer, and into the perfect insect the end of August or beginning of September. The chrysalis has brilliant golden yellow patches on the sides, and is a very pretty object. The specimens which appear early in the summer are those which have hibernated in the winter. The autumn or late summer specimens are the best for the collector's box. Rivalling the Red Admiral in point of beauty and brilliancy of colours, the glorious Peacock (*Vanessa Io*) claims a notice, with wings of deep red, margined with brown, chiefly conspicuous for the large eye-like spots, variously and beautifully coloured, which adorn the wings. The perfect insect appears in July, but speci-

mens that have hibernated appear earlier ; the larva is black, sprinkled with minute dots with spines on its segments. Like the larva of the Red Admiral, it feeds on the nettle. Though common in England, it is scarce in Scotland.

The Tortoise-shells large and small (*Vanessa polychloros*, and *V. urticæ*), the latter of which is extremely common everywhere, the former not being so abundant, belong to this family. All the species of the genus *Vanessa* have more or less a ragged or scalloped outline. This is very conspicuous in the Comma Butterfly (*Grapta C-album*), so called from a central C-like mark on the hind wings. This species is scarce.

But perhaps the greatest prizes in this family of the Nymphalidæ are the Camberwell Beauty (*Vanessa Antiopa*) and Purple Emperor (*Apatura Iris*). The former is capricious in its appearance, and few Entomologists indeed have ever seen it on the wing. The wings are purplish chocolate, margined with yellowish white, adjoining which is a broad black band, with six or seven blue spots to each wing. It is the largest of the Vanessas ; "Longo post tempore venit" is expressive of the appearance of this butterfly. When it has appeared it sometimes occurs in great numbers. About eighty years ago, after a long absence, it appeared somewhere in great number, and received the name of "The Grand Surprise," and its appearance at Camberwell some years ago caused it to be called the Camberwell Beauty, a name it still retains.

The Purple Emperor is perhaps the most splendid of our native butterflies, the iridescent gloss of the wings in the male in certain lights equalling in bril-

liancy that of some of the South American insects. It is a strong flyer, and makes his throne on the lofty branches of oak trees. Entomologists of former days used a ring-net, fastened on the end of a rod thirty or forty feet long, an instrument which must require some practice to handle with effect. But now, collectors wait till his majesty descends from his throne, and comes to the ground for eating or drinking, in which matters he is not so particular as befits imperial purple, for he prefers muddy places to drink from—water containing much "body"—to borrow a phrase from the wine merchant. Dead dogs and cats, in a high and semi-fluid state of decomposition, are favourite food, and if such baits are placed in places where these butterflies occur, specimens may be secured without difficulty, his majesty being too much occupied with his meal to be scared away. Woods in the south of England are this butterfly's localities. I have never heard of any specimen being seen in Shropshire or Staffordshire. The larva is pale green, with oblique yellow lines, and a yellow stripe on each side. On the head are two snail-like tentacles or horns ; it feeds on poplars and sallows, in May. I should mention that the under sides of the Emperor's wings are prettily marbled with red, white, and brown. The Fritillaries are pretty members of this same family ; they all have metallic spots and marks on the under surface of the lower wings, giving to them a burnished silver appearance. There are several British species belonging to the genera *Argynnis* and *Melitœa* ; the larvæ are spiny, and feed generally on wild violets.

The Erycinidæ family has only one British species :

this is the *Nemeobius lucina*, the male of which has only four developed feet, as was said above. It occurs in open glades in the South of England in woods in June and August. The larva, which is of a wood-louse form, feeds on the primrose.

The family of *Lycœnidæ* contains the little Blue butterflies so common in meadows, lanes, gardens, heathy downs, &c.; the Hair-streaks, brown and orange, or purple, and the Coppers, belonging to these three genera respectively, *Polyommatus*, *Thecla*, and *Chrysophanus*. Most of the species are rather small in size, and fly low near the ground in a short jerky manner. The blues vary in colour, some females are brown, or purplish-brown; some are brown with orange spots; some are brown in both sexes. From the presence of a number of small eye-like spots on the under surface of the wings, this genus has received the name of Polyommatus, "many-eyed." In the genus *Thecla* the hind-wings have short tails—a distinguishing mark, with one exception, viz., the Green Hair Streak (*Thecla rubi*), so called from the colour of the under surface of the wings. The tails here are absent, or barely distinguishable. In *Chrysophanus*, the fore-wings are coppery-red, with dark hind margin, and often a black spot or two near the middle; only one species, I believe, now represents this genus, viz., the small Copper (*C. phlæas*), which may be known by its bright copper-red fore-wings, with black spots, its hind-wings very dark, with copper-red margin. It is common everywhere. Two other species, the Large Copper (*C. dispar*), and the *C. Chryseis*, formerly occasionally seen in some parts of England, appear to have disappeared altogether. The former, *dispar* (so-called from the dis-

similarity in the colouring of the male and female) used to frequent the fens of Cambridge and Huntingdon : the latter has been taken, many years ago, in Epping and Ashdown forests.

The *Hesperidæ* includes the "skippers"—so called from their short, jerky flight—of which there are seven British species ; all are of small size, and generally brown or yellowish in colour. The species belonging to this family approach the *Heterocera*, or moths, in some respects, both in form and habit ; the body is thicker in proportion than is usual in butterflies, the tibia have only one pair of spines, like moths. In some species the fore-wings are erect while at rest, the hind-wings folding the body horizontally. The antennæ are widely separated at their insertion on each side of the head ; the larva spins a cocoon, as do many moths. Many of the species of Hesperidæ are local. *Thymele alveolus*, the grizzled skipper, with wings nearly black, tinged with green, and sprinkled with white spots, is not uncommon in woods.

The HETEROCERA, or Moth section of the Lepidoptera, may be divided into the nine following groups or families :—

1. Sphingina.
2. Bombycina.
3. Noctuina.
4. Geometrina.
5. Pyralidina.
6. Tortricina.
7. Tineina.
8. Pterophorina.
9. Alucitina.

The first family, the *Sphingina*, or Sphinx moths, derives its name from a fanciful resemblance of some of the larvæ to the famed sphinx of Egypt; the term Hawk-moths, by which they are also called, refers to the hawk-like swiftness of their flight. The Sphingina are at once to be known by the form of the antennæ, which are thickest in the middle; in the other groups these organs are the thickest at the base, gradually tapering towards the tip. Most of these moths fly by night, or in the dusk of the evenings; the beautiful and bold Humming-bird Moth (*Macroglossa stellatarum*), however, flies by day and delights in the hot sunshine. These moths are of a large size, and are conspicuous for the beauty of their colouring; the larvæ also of some of the species are prettily marked, being of a bright apple-green colour, with handsome lilac stripes. The curious Death's-head Moth (*Acheront'a atropos*) belongs to this group. Other species are the Spurge Hawk-moth (*Deilephila Euphorbiæ*), very rare in this country, but occasionally abundant on the Continent, near the coast; the Eyed Hawk-moth (*Smerinthus ocellatus*), the Poplar Hawk-moth (*S. populi*), the Lime Hawk (*S. tiliæ*), all of which are heavy fliers, unlike the Swift hawks of all the other species; then there is the common Privet Hawk (*Sphinx ligustri*), the Elephant Hawk (*Chærocampa Elpenor*), so called from the resemblance more or less fanciful of the head of the larva to the trunk of the elephant. It is an ugly creature, and has two eye-like spots on the fifth and sixth segments, which at first sight might be supposed to be really eyes. Some of the Hawks have very long tongues, even longer than their bodies, by means of which they can reach the

honeyed measures from long flower-tubes. The Death's-head, however, has a short, thick tongue, and when this moth wishes for honey, it enters bees' hives and robs the insects of it, or else, perhaps, feeds on the juices of very ripe fruit. This magnificent moth is undeservedly in ill repute on account of the very curious and conspicuous markings on its thorax, representing a human skull with thigh-bones crossed beneath, which superstitious people regard with horror, as they suppose the insect

Larva of Privet Hawk-Moth (*Sphinx ligustri*).

presages death. Another curious fact about this Hawk-moth is its faculty of uttering a cry or squeak like that of a mouse, or the creaking of cork; this adds to the horror with which it is regarded. I have on two or three occasions heard this peculiar squeak, but could not make out how the sound was produced. I believe the question is still a problem. According to a writer in *Notes and Queries*, there is a quaint superstition that the Death's-head Moth has been very common in White-

hall ever since the execution of Charles I. The larvæ are very large, and lemon-yellow in colour, with seven oblique violet stripes. They feed on the potato, jasmine, and *Lycium barbarum*, known in some counties as the "tea-tree." The perfect insect appears towards

Death's-Head Hawk-Moth (*Acherontia atropos*).

the end of August, and remains even till October. The three species of *Smerinthus* and *Chœrocampa porcellus* (Small Elephant Hawk), appear at the end of May if the weather be warm. The Humming-bird Moths may not unfrequently be seen hovering before flowers in gardens.

In some seasons they appear in very great numbers in some localities. The larvæ feed on bed-straw (*Galium Mollugo*). A drawing of the Humming-bird Moth will be seen on Plate III., Fig. 4. The flight of this moth is amazingly swift. To this same group also belongs the curious wasp-like or bee-like moths called Clearwings (Plate III., Fig. 7), from the absence of scales on the wings except at the margins ; these are *Sesia fuciformis* or broad-bordered Bee-hawk, *S. Bombyliformis*, the narrow bordered Bee-hawk, *Sphecia apiformis*, whose figure appears in the illustration, *S. Bembeciformis*, and various species of *Trochilium*. In all these species the wings are more or less transparent, with a black edge ; the upper wings are generally barred with brown, orange, and black. The bodies of the genus Trochilium are slender. At the end of the abdomen there is a brush-like tuft, more or less conspicuous.

Of all our British moths, Mr. Newman says, the *Sesiidæ* are the most elegant, graceful, and fairy-like. Unlike almost all other moths, they fly in sunshine, and nothing can exceed the grace and beauty of their motions as they hover over a flower, or walk over its petals and leaves, gently waving their transparent and sylph-like wings. The most remarkable character that belongs to these moths is this:—they seem to have no similarity at all to other moths, but rather resemble gnats, and bees and wasps, and a variety of other insects. The hornet-like appearance of the Sesia apiformis is obvious at a glance. The larva feeds on the wood of poplars and aspens, into which it burrows. Here it changes after two years of larva-life into a pupa, the perfect insect appearing about midsummer.

The prettily-marked Burnet moths (*Anthrocera*) belong also to this group, the commonest species being the six-spot Burnet *A. filipendulæ*). It has the upper wings of a deep metallic green colour, with six crimson spots; the hind wings are deep crimson, edged with a narrow black border. The caterpillar is dull yellow, somewhat hairy, with two rows of black spots on each segment. It feeds on clover and other leguminous plants. When about to assume the pupa state, the caterpillar creeps up the stem of some grass, rush, or other plant, and on it spins a yellow silken cocoon, pointed at both ends. In this case it changes to a black chrysalis—the beautiful moth appearing early in June. The second group, the Bombycina, as well as all the other groups of the Heteroceral Lepidoptera, has the antennæ thickest at the base, gradually tapering towards the tip. The Bombycina includes the Swifts, the Ghost moths, the wood Leopard and Goat moths, the Puss, Lobster, Buff-tips, the curious Tussocks, Vapourers, Gold-tails, Ermines, Tiger moths, Eggers, Lackeys, Drinkers, Lappets, the Kentish Glory, the Emperor, &c. The common Silkworm moths of commerce belong to this group.

The Swifts, so-called from the rapid flight of most of the species, are remarkable for their very short antennæ. The Ghost Swift (*Hepialus humuli*) is common everywhere. The wings of the male are of a silvery white, the fore-wings of the female yellow, with orange spots, hind-wings dull at the base, tawny towards the margin. The Goat moth (*Cossus ligniperda*) derives its name from the offensive goat-like smell of the caterpillar, a formidable fellow, with black head and strong jaws, a fat body as thick as a man's finger. It feeds

on various trees—willows, oak, elms, &c., and as the larva does not change into a pupa for four years, it is capable of doing great damage. The moth is a large insect, three inches across the wings, with broad pale brown wings, elegantly marked with wavy lines. The Puss moth (*Cerura vinula*), derives its name from the soft texture of the scales, reminding one of some smooth tabby cat, is tolerably common, and very beautifully marked with delicate pencillings. The larva is a strange looking creature, with a forked tail; it is dark green, and has a hump on the fourth segment. It feeds on willows and poplars, and forms an oval cocoon, in which it changes to a chrysalis, and appears in the spring. A still more remarkable form of larva is that of the Lobster-moth (*Stauropus*), which carries its two-forked tail elevated somewhat in the same way as a lobster elevates a claw. It feeds on beech, oak, and birch. There is only one species, the *S. fagi*, and this is scarce. The Buff-tips (*Pygœra bucephala*) are very common and handsome little moths. They derive their name from the presence of a large buff patch at the tip of each wing. As this moth lies among the fallen leaves on the ground, it is scarcely distinguishable from a broken stick. The Tussocks are very beautifully coloured moths. They

Larva of the Lobster-Moth (*Stauropus fagi*).

are so called from the larvæ bearing numerous thick tufts of silky hairs on some segments of the body. The Pale Tussock larva (*Dasychira pudibunda*) is found on hops; in the hop-gardens it is known as the "hop-dog;" it is of a pale yellowish or straw colour, and the incisions between some of the segments are deep black, like velvet. On the fifth to the eighth segment there is a dense yellow tuft on the back. On the twelfth segment a longer dull

Wingless Moths.

red tuft appears. It is a beautiful creature, and immediately attracts attention. The Common Vapourer demands a short notice, inasmuch as the females of this genus (*Orgyia*) are dull wingless grub-like creatures, so unlike nearly all other Lepidopterous insects. The Vapourer (*O. antiqua*) is entirely destitute of wings, and is covered with grey down. The wings of the male are bright chestnut, the fore-wings having darker markings. The caterpillar has tussocks on some of the segments. It

will eat almost any kind of plant. After the female comes out from the web, she lays her eggs all over it, and there she remains. I must pass over, for want of space, the pretty Ermines, Eggers, Lackeys, and Drinkers, except to say that the commonest and perhaps most beautiful of the Ermines is the White Ermine (*Spilosoma menthrastri*) so called on account of the resemblance of its covering to the fur of the ermine, that the Egger moths take their name from the oval shaped cocoons of the chrysalis, that the Drinker (*Odonestis potatoria*) is so called from the habit the caterpillar has of putting its mouth to a dewdrop and sucking up the whole of it. I pass on to notice a very curious moth, the Lappet (*Gastropacha quercifolia*), (Plate III. Fig. 6), of a beautiful brownish red or mahogany colour, marked with darker zig-zag transverse lines. The hind margins of all the wings are prettily and regularly scalloped, the antennæ are beautifully pectinated. The caterpillar is large and variable in colour, grey or pale brown. There is a slight hump on the twelfth segment, and the incisions between the second and fourth segments are dark purple. It feeds on the willow and blackthorn, and spins a black, firm cocoon among the lower twigs. The perfect insect appears in June and July.

Above the Lappet, and to the right (Fig. 5) will be seen a drawing of the richly marked Tiger-moth (*Arctia caja*), common everywhere towards the end of summer. The larva is of large size, with a great number of long white hairs on the back, and dark brown hairs along the sides. It feeds on various plants, and spins a loose hairy web in July, in which it turns to a smooth, black chrysalis. The Kentish Glory (*Endromis versicolor*), a beautiful

moth, with orange brown wings, variegated with many curved black and white streaks, once not uncommon in Kent, is now very rare there. It has, however, been taken in large numbers in the Rannoch woods, near Perth. I must not omit to mention the Emperor moth (*Saturnia Pavonia minor*), with its four eye-like spots in a yellow ring surrounded by a black one, and wings prettily variegated with brown, red, grey, and orange. It appears in April.

Caterpillar of the Tiger-Moth, or Woolly Bear.

The *Psychidæ* family belongs also to the Bombycina group. In it the females are even more helpless creatures than those of the Vapourers; for not only are they destitute of wings, they have neither legs nor antennæ. The female is a mere bag of eggs, never quitting the covering in which it was bred. The larva constructs a moveable case in which it lives and undergoes its metamorphosis. This house-building peculiarity will remind us of the Caddis Worm insects I have already spoken of. These larvæ must be looked for in spring and summer.

The third group, that of the *Noctuinæ*, contains about 300 British species, As their name implies, these moths fly, as a rule. by night, but there are day-flying species.

as well. They are fond of sweets, and it is for the various members of this group that the entomologist plasters over with sugar and beer the trees of his garden for the capture of specimens. Their bodies are generally stout and smaller than the other two groups; their fore-wings are narrow, and fold over the broader hind-wings. The antennæ generally are slender. A certain pattern occurs very constantly in the markings of the

Night-Flying Moths.

1. Cosmia Pyralina, Lunar Spotted Pinion-Moth.
2. Lackey-Moth (*Bombyx neustria*).
3. The Sprawler (*Petasia cassinea*).

fore-wings; thus, near the *costa* (*i.e.*, front edge of the wings) of the fore-wings, about the middle, are two spots called the stigmata; that nearest the base is round or oval, and is therefore called the orbicular stigma; the other is kidney shaped, and is called the reniform stigma; beneath the orbicular stigma is frequently a third, of a wedge shape, called the claviform stigma. There are moreover certain lines that run transversely along the

wings. As a rule, the colouring in the members of this group is not conspicuous, though some species are striking enough, the Red Underwing, for instance, a large greyish moth, with red hind-wings, barred with broad black bands; the splendid Clifden Nonpareil (*Catocala fraxini*), with fore-wings marbled grey, and hind-wings rich lilac, bordered with deep black, though it is doubtful whether this magnificent moth—about four inches in the expanse of the wings—is properly a native. The Plusias are very beautiful, glittering with gold and silver.

The *Geometrina* derives its name from the peculiar mode of locomotion in the larvæ, or "looper" caterpillars, as they are called. The creature attaches its hind-legs to the substance on which it is walking, stretches out its body to its full length, depresses its fore part, and grasps with its fore-legs, bringing up the hind-legs to them, in this way forming for a time a loop. It then stretches out the fore part again, repeating the process as before. The larvæ, having only ten legs, are obliged to adopt this mode of migration. Mr. Stainton says we have upwards of 260 British species; all have slender bodies when contrasted with the Noctuina and Bombycina, most rest with wings extended, and a few with them erect like the butterflies. I have space only for mentioning two or three species of this group; one of the commonest and prettiest—here, at least, in Shropshire—is the Swallow-tail moth (*Ourapteryx sambucaria*), so called from the hind-wings being prolonged into a kind of tail. The wings are of a light yellow, with several pale olive transverse streaks. It is very like a small brimstone butterfly, but its tapering

antennæ proclaim it to be a moth. It flies at dusk, and is readily captured, making its appearance in July. It is unknown in Scotland.

The larva has several small lumps on some of the segments. It is yellowish or reddish brown in colour, with paler longitudinal streaks. It feeds on oak, bramble, elder (hence the specific name), and ivy. The chrysalis is contained in a suspended cocoon. The Emerald moths, remarkably handsome for the beautiful green, like grass or emerald, which, however, very soon fades, belong to the group. The Magpie moth (*Abraxas grossularia*), spotted black and white, with a yellow patch at the base of each wing, sometimes called the Currant or Gooseberry moth, from its depositing its eggs and the larvæ feeding on the leaves of the black currant and gooseberry, is extremely common in gardens, where the caterpillar, which is marked very like the perfect insect, often does considerable damage. After feeding for a few weeks the larva spins together the edges of a leaf, after having fastened it to a twig by a number of silk threads. Here it remains as a larva all the winter. Early in spring, when the gooseberry tree puts forth its green leaves, the larvæ, to use Mr. Newman's words, "cuts an opening in his pensile cradle, emerges, and begins to eat." It is full fed in May, when it spins a transparent cocoon, in which it changes to a chrysalis, the moth appearing about midsummer. It is very variable in its markings. The species in this group are elegantly formed, and the wings often delicately pencilled.

The group to which I now come (*Pyralidina*) is less extensive than the two previous ones. The fore-wings are long and triangular, the whole outline of the insect,

in repose, forming a well defined triangle; a long sharp snout, formed by the elongated palpi, is characteristic of many moths in this group, which includes Meal-worm moths, Pearl moths, from the peculiar lustre of the wings. These Snout moths may be seen in great numbers in grass fields intended to be mown, sporting themselves in the sunshine, and settling on the bents of grass, head-downwards, where they remain stationary and, owing to their inconspicuous colouring, difficult of detection. The China-mark moths (*Hydrocampa*) belong to this same group. This genus is remarkable in the fact of the larvæ being aquatic, hence the Greek name, "Water-caterpillar," which distinguishes it.

"Of all the *Lepidoptera* the *Hydrocampidæ* are perhaps the most extraordinary, so far as their methods of life are concerned. The moths fly and enjoy the air as much as any others, and cannot be distinguished from those whose caterpillars live on dry land. Their breathing apparatus is like that of other moths, and they have the habits of the other night-flyers. But the caterpillars live in the water, surrounded by a great bubble of air, and others positively have gills or branchiæ, and are surrounded and bathed by water. This is a most extraordinary fact, for the moths which are produced by metamorphosis from these caterpillars resemble each other to a great extent, and it shows how slight the distinction may be between aquatic and air-breathing animals, and how nearly the origin of the separate conditions may be allied."* The pupa is enclosed in a cocoon, the case of the larva. The China

* Transf. of Insects, p. 130.

marked moths—so called from their porcelain-like delicacy of tone—are very common near ponds where duckweed and water-lilies grow. One of the readiest procurable species in the larval state is the *Hydrocampa nymphæata*, or Brown China-mark. If the under surface of the water-lily leaves be examined, there will often be seen attached flat cases which, on examination, will be found to contain the black-headed larvæ.

The *Tortricina* includes those moths whose caterpillars twist up and fold together the margins of various kinds of leaves, or unite them in bundles by means of their silken threads. There are about 300 British species. Owing to the similarity of colouring and general dullness of marking, the members of this group are less attractive than other Lepidoptera; they are also very variable, the species running into as many as twenty or thirty varieties. They are generally of a small size, the body is short and slender, the fore-wings are broad and blunt, and have a peculiar wave or curve, so that the insect, when at rest, is somewhat bell-shaped. Some of the species are eminently destructive. The Vine moth (*Oenectra pilleriana*), which has proved so fearful a pest in France, is one of this family. Mr. Stainton found the larva in the seeds of the Stinking Iris, near Ventnor, but it is rare. Mr. Duncan gives us a curious story in connection with the Vine moth. "Many years ago one of the moths which are so injurious to the vine became common in Savoy, and after a year or two the caterpillars began to do great mischief. The unfortunate farmers applied to the Archbishop, and requested him to curse the caterpillars, as they were doing a great deal of injury. The Archbishop, being a merciful man, did

not think the insects were to blame, because they were only indulging in those habits which were necessary for their existence. And he also considered that they were sent as a punishment to the vineyard men, who had not paid up all their tithes. Consequently, he ordered the Bishop to open a court, where the farmers and the insects were to appear by counsel. A long trial took place, and a commission was ordered to inquire into the truth of the allegations of the farmers; but of course, while this was being done the caterpillars had metamorphosed, and the mischief was completed. Many years afterwards the moths and caterpillars re-appeared, and then the farmers proposed to set apart a particular plot of ground for the insects, which were to be under the charge of the Church, and petitioned that if they did this the Archbishop should curse the rest, and allow all those out of bounds to be destroyed. The Archbishop, considering that the Church gained a nice piece of ground by this transaction, willingly agreed to form a procession round the country, and to do the required cursing; after which, however, the farmers were to do penance, and to pay up all their tithes."

In our own country there is, perhaps, only one highly destructive species, viz., the Green Tortrix (*T. viridana*) whose larvæ in countless multitudes bare oak trees of their leaves in the early summer months. The larva and perfect insect are green.

The *Tineina* is a very extensive group, the British species being computed by Mr. Stainton, one of our highest authorities on the Lepidoptera, at about 650 in number, thus outnumbering any two of the preceding groups. The moths are small and fragile, the most

conspicuous character being the great length of the hairs which fringe the margins of the wings. The

Larvæ of *Tinea tapetzella*.

common Clothes moths, and the beautiful Leaf-miners, belong to this group. The habits of the larvæ vary much; some feed externally, others in rolled up leaves,

others are miners, some case-bearers, some feed on clothes, or in the linings of sofas, etc., etc. (Stainton). I have just found some little *tinea* in an insect box, the larva of which had selected a pinned down specimen of the Burnished-brass moth (*Plusia chrysitis*), had constructed out of its remains a tube which it erected like a column, and in which it passed through its changes. The British species of tinea, which are injurious to clothes, etc., are *Tinea tapetzella*, a common species often found in carriages, the larva feeding under a gallery constructed from the lining; *T. pellionella*, the larva of which constructs a portable case out of the substance in which it feeds, and is very partial to feathers. *T. biselliata* is often found abundantly in horse-hair linings of chairs. I must mention the genus *Adela*, containing the Long-horn moths, the antennæ of the males being of extraordinary length. The *Adela Degeerella* is a beautiful insect, a wing under the microscope being like burnished gold, richly tinted with purple. The larva feeds on the wood anemone.

The *Pterophorina* is a very small group, as represented in this country. The fore-wings are cleft more or less deeply. The hind-wings are split into three distinct feathers; hence they are often called *Plume* moths. The perfect insects appear in October, and, hybernating, are seen again in the spring.

In the *Alucitina*, of which group there is only one British species (*Alucita polydactyla*), each wing is divided almost from the base into six distinct feathers (see Plate III., Fig. 8). It is a prettily marked and elegant little moth, common in houses and outbuildings, on the walls of which it may be seen resting with

DIPTERA.

expanded wings, like the fan of some fairy queen. The larvæ feed on the unopened buds of the honeysuckle, and spin cocoons, in which they change to the chrysalis state.

DIPTERA

In the Order Diptera the insects, as the name implies, have only a single pair of wings; but some Entomologists include in this order the species of the family *Pulicidæ*, or fleas which are entirely destitute of wings. Mr. Francis Walker, one of our great authorities on two-winged insects, and who has published a very valuable monograph of them, divides the Diptera into these three great groups: (1) Suctoridia, (2) Proboscidia, (3) Eproboscidia.

The first group, corresponding to the Order *Aphanitera* of other Entomologists, contains only the *pulicidæ*, or family of fleas of which there are several species parasites on various animals. Fleas differ so materially in many of their characters from two-winged insects, that it is, perhaps, better to regard them as belonging to a separate order. Everyone is familiar with this active little hopper, both as to appearance and the results of its bite. Although the flea has no wings, it has the rudiments of four wings, in the form of horny plates, on the thorax; the mouth is a very complicated organ, being furnished with a pair of sharp sword-shaped blades and a needle-like body, the whole being sheathed by the labial palpi. The hinder legs are very long, and

the thighs thick and strong, forming admirable leaping organs. The larva of the flea is a long footless grub with a horny head. Fleas lay their eggs in cracks in the boards of rooms, in dust, or other undisturbed places; but those species, which are parasitic on dogs, cats, squirrels, and moles, lay the eggs amongst the hair, and the larvæ feed on minute particles of animal matter. In about a fortnight the larvæ are full grown, they then shut themselves up in silken cocoons and change to pupæ, in which condition they remain for about another fortnight, when the perfect insects appear. Animals have their own peculiar species of flea-parasites, but the species belonging to one will sometimes attack another. The dog-flea (*Pulex canis*), for instance, is smaller than the human-flea, and is a distinct species, yet it will attack men; the same may be said of the *P. gallinæ*, so common in hens' nests. The flea that infests the squirrel is one of the largest with which I am acquainted, but that of the badger is larger still. The Jigger or Chigoe (*Pulex penetrans*) of the West Indies and North America inserts itself beneath the skin or under the nails of the foot. Here the female develops her eggs in the ovaries until she becomes as large as a pea; if the pest is not extracted, it produces ulcerations, giving much pain and trouble.

The great security against annoyance from fleas is cleanliness; various plants have been supposed to be efficacious in driving away fleas, such as *Erigeron*, *Conyza*, *Pulicaria*, etc., to which the term "flea-bane" has been applied. Old Tusser recommends cleanliness and worm-

wood; he says something like this, for I quote from memory :—

> "When wormwood hath seed, get a handful or twain
> To save against March, to make flea to refrain—
> Where chamber is swept and wormwood is strown,
> No flea for his life dare abide to be known."

My own experience leads me to believe in the efficacy of the strong-smelling wormwood (*Artemisia*).

We pass now to the true *Diptera*, which, as has been said, are chiefly characterised by their having only two wings attached to the mesothorax; on the metathorax will be seen a pair of small projections, footstalks with a round knob at the top, called *halteres* or *poisers*; these are also very characteristic, being always present, even when the true wings are absent; these organs are generally regarded as modifications of the posterior wings. What their function is, is not certainly known; Mr. Lowne is disposed to regard them as organs of hearing. The larvæ of the Diptera are footless grubs; the order includes an enormous number of species.

The Order Diptera is divided into two great groups or sections, viz., the PROBOSCIDIA and the EPROBOSCIDIA; in the former, which contains nearly the whole of the order, the proboscis is fleshy, ending in a biloped piece; the head is attached to the thorax by a slender neck; the antennæ are inserted in front of the head, between the eyes; wings and halteres developed almost always. In the latter section the proboscis is tubular, the head sunk in the thorax, showing no distinct neck, antennæ set in furrows near the mouth; wings and halteres most often imperfect or none. The latter group contains only a

few species, all of which are parasitic on mammalia and birds, feeding on the substance at the roots of the hairs and feathers.

The first section is divided into two large sub-sections, to which, from the characters of the antennæ, the names of *Nemocĕra* and *Brachycĕra* have been given. In the first the antennæ are long and thread-like, with a great number of joints, such as those of the Gnats, Daddy long-legs, etc. In the second sub-section the antennæ are short and often consist of only three joints of an equal size, the last being often furnished with a long bristle. Besides the Nemocĕra and Brachycĕra there is a third sub-section, which contains a very few species, the *Hypocera*, in which the antennæ are situated not between the eyes, but low down near the mouth. The *Brachycĕra* section is by far the largest. The *Nemocĕra* has been divided into two families by Mr. Francis Walker; space of necessity compels me to confine my remarks to a few only.

The *Mycetophilidæ* are chiefly fungus-eating flies, eaters of decayed vegetable matter, in their larval condition; they inhabit woods, are small, and have legs formed for leaping. The larvæ are common in the growing stems of hollow-stalked agarics. As consumers of decayed vegetable matter they are serviceable.

The *Cecidomyzidæ* or gall-gnats are, to use Mr. F. Walker's words, "the most elegant and delicate little creatures in the whole of the *Diptera*." The wings are often beautifully iridescent; the antennæ long and graceful. The larvæ, fleshy oval grubs, feed on various living plants, and are thus more or less injurious to vegetation; some form galls, others feed on decayed

wood. "The wart-like galls common on the meadow sweet (*Spiraea*); the uneven swellings on the stalks and leaves of the stinging-nettle; the little furry purses on the ground-ivy; the woody, shapeless excrescences on the raspberry plants; the slender upright growth on beech leaves; the blisters on bed straw, yellow nettle, and others; the knots within the very blossoms of many flowers—all these, and a great many more, are the work of little creatures in this numerous family" (Staveley).

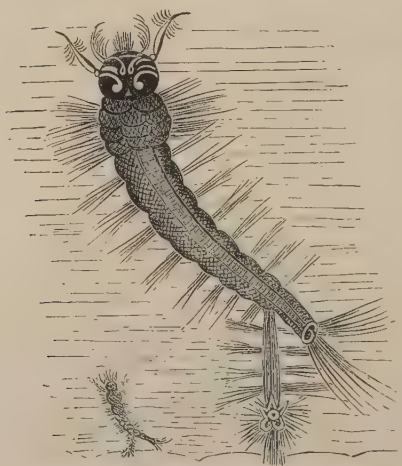
On Plate IV. (Fig. 1) will be seen a magnified drawing of the Wheat-midge (*Cecidomyia tritici*), the larvæ of which occasionally do much mischief to the wheat crops. This insect is a near relative of the Hessian-fly, the North American scourge, whose ravages have even caused famine in the land. The larvæ of the Wheat-midge feed on the flower of the wheat, rendering it abortive. The eggs are laid in June, the larvæ changing to pupæ upon the sound grains and inner valves, or entering the ground for that purpose, the perfect insects hatching in the summer.

The *Bibionidæ* I have represented on Plate IV., Fig. 8, by the well-known *Bibio Marci*, the Hawthorn-fly of the angler, whose deep black bodies and white wings of the male, and long legs pointing backwards, must be familiar to the most unobservant. The larvæ feed on the roots of grass; they are worm-like and cylindrical, with transverse rows of short hairs, serving for locomotion; the pupæ are naked, enclosed in a smooth oval cell. The perfect insect appears towards the end of April, about St. Mark's day, hence the specific name of the insect *Marci*.

The *Simulidæ*, *Chironomydæ*, and *Culicidæ*, are emi-

nent blood-suckers. The Simulidæ or Sand-flies are fortunately represented in this country by few species, only two being generally distributed. They are even more troublesome than gnats or mosquitoes in the northern parts of Europe and in several parts of North and South America, where they abound. They are found in damp marshy places and fly in great swarms, and bite severely. In the Bannat of Temesvar, in Hungary, the myriads of *Simulium Colombaschense* often prove fatal, not only to cattle, but to mankind.

The family of the *Chironomydæ* contains the Midges, small gnat-like insects, whose larvæ live in water or in wet ground, but a few dwell beneath the bark of trees; some species occur in innumerable multitudes, and must contribute, as Mr. F. Walker says, "to remove or change the decaying vegetable matter, which is their earliest food." These insects may be often seen in summer evenings in immense swarms hovering in the air. The larva of *Chironomus plumosus* is the blood-worm, so abundant in stagnant water. The

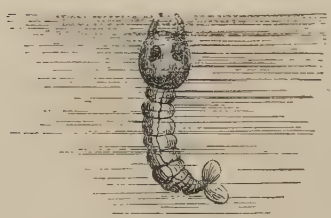


Larva of Gnat (natural size and magnified).

larvæ of this species, like those of some species of *Cecidomyia*, is capable of producing creatures like itself.

The *Culicidæ* contains the Gnats, or, as they are called in some countries, Mosquitoes, *i.e.*, "little flies," from *muscus*, a fly. These insects are plentiful in all countries, whether arctic or tropical, which abound in wood and water. The drawing (Fig. 7) represents the common gnat *Culex pipiens*, the blood-thirsty pest in warm summer nights, which disturbs the sleeper. The males, which may be distinguished by their pretty hairy antennæ, are harmless in this respect; it is the female that sucks blood. The eggs are formed in the shape of a little raft or boat between the long hind-legs, and left to its fate on the water; the larvæ must be familiar to all who have occasionally looked into the rain-tub or stagnant pools of water; they are big-headed twisting creatures, that move pretty rapidly in the water by jerky motions; they ascend to the surface of the water and expose their tail end (which is provided with a long respiratory organ radiated at the tip) to the air, with the head downwards; the pupa, like the larva, is active; it has two ear-like organs on the thorax very conspicuous, which are its organs of respiration. These gnats sometimes occur in such enormous quantities in warm summer evenings as to look exactly like columns of smoke, for which, indeed, they have been mistaken. Many years ago a dense swarm of gnats was seen issuing from the spire of Salisbury Cathedral, which, being taken for smoke, gave rise to an alarm of fire. The peculiar shrill trumpet-like sound of the female—the prelude to an attack on your face or other exposed part of the body—is probably produced by the rapid vibrations

of the wings. When flying in the early Spring, gnats emit no sound. "The warmer the weather, the greater is their thirst for blood, the more forcible their flight, the motion of the wings more rapid, and the sound produced by that motion more intense." The two most common house-inhabiting gnats are *Culex pipiens* (*ciliaris*) and *C. annulatus*. The genus *Corethra* is remarkable for the curious form and structure of the larva. It is a long worm-like creature as clear as crystal; the head is furnished with two deflexed hooks; at the end of the abdomen is a fan of hairs; unlike the larva of Culex, the Corethra larva suspends itself in a horizontal position in the water. There are two



Pupa of Gnat (*Corethra plumicornis*).

Larva of Gnat (*Corethra plumicornis*).

curious oblong vesicles of considerable size in the thorax, and a pair of smaller ones towards the end of the tail; these organs are respiratory. The name of Mosquito is sometimes applied to a *Simulium*, sometimes to a *Culex*. These insects are much more formidable pests in some countries than the species are which are found in this country. Although the indi-

viduals are so exceedingly numerous, the genera are few; Mr. F. Walker enumerating only five.

Some of the *Phlebotomidæ* are allied to the preceding family, and are blood-suckers, while others are harmless. The extremely common little insects so often seen on window panes with broad sloping wings is one of this

DADDY-LONG-LEGS (*Tipula oleracea.*)

family. Its wings are thickly covered with hairs, and it is not unlike a small moth. Its name is *Psychoda phalænoides;* the larva inhabits dry cow dung and decayed vegetable matter. It is often popularly, though erroneously, called a midge.

The *Tipulidæ* are distinguished at once by their very

long legs. "Crane-flies" and "Daddy-long-legs" belong to this family. In size and variety of structure these flies exceed all the other *Nemocera*. The genus *Chionea*, not found in this country, is quite destitute of wings, and is remarkable from its occurring only on newly-fallen snow in the winter. The species of this family have a transverse suture on the mesothorax, a character not occurring in the other groups. The Daddy-long-legs (*Tipula oleracea*) is very common, and known to everyone (Plate IV., Fig. 6); the horny-pointed pincers terminating the abdomen in the female form the oviduct, by means of which she pierces the ground and lay her eggs in it. When engaged in laying eggs she moves over the grass with her body in a verticle position, with her fore-legs in the air; "when upon the wing the fore-legs are placed horizontally, pointing forward, and the four hind ones stretched out in an opposite direction, the one forming the prow and the other the stern of the vessel through the air." The eggs of the Daddy-long-legs are oval conical grains, black and shining. The larvæ are very injurious in grass lands, as well as in gardens, amongst the cabbages—hence the specific name of this fly; but scarlet beans, lettuces, dahlias, carnatians, all sometimes suffer. The larvæ, when full-grown, are about an inch long, cylindrical, and about as thick as a small goose quill; they have very tough skins, and in consequence, in some counties, they are called "Leather-jackets." They move by wriggling along, for they have no feet. The pupæ appear in August and September, at which time thousands of empty cases may often be seen protruding half way out of the earth amongst grass, and by the sides of gravel

walks. Rooks and starlings destroy great numbers of these injurious larvæ; the little burrowing mole also may fairly lay claim to be the farmers' friend in this respect—for I have found in the stomachs of the gibbeted moles the remains of these Tipulæ and other kindred larvæ.

Mr. F. Walker divides the BRACHYCERA into seventeen families, as follows :—

1. Acroceridæ.
2. Scenopinidæ.
3. Stratiomidæ.
4. Tabanidæ.
5. Xylophagidæ.
6. Asilidæ.
7. Leptidæ.
8. Bombylidæ.
9. Empidæ.
10. Dolichopidæ.
11. Lonchopteridæ.
12. Syrphidæ.
13. Conopidæ.
14. Platypezidæ.
15. Pipunculidæ.
16. Muscidæ.
17. Œstridæ.

In the *Acroceridæ*, a family which contains a very few species, the bodies of the insects are broad and globose, the head very small and almost wholly occupied by the eyes; they are sluggish in their habits, and often group themselves on withered trunks of trees, flying about in the sunshine.

The family of *Scenopinidæ* contains a few small black flies of sluggish habits ; they are found on leaves of plants, and on windows, especially of stables.

The *Stratiomidæ* or Soldier-flies have bodies rather flat, of large, middle, or small size ; they inhabit flowers, leaves, meadow and water plants ; the larvæ are aquatic or live in decomposing matter ; there are several species, but I shall mention two only, the *Stratiomys Chameleo* and the *Sargus cuprarius*. The former is prettily marked in spots and bands, black and yellow. These insects fly with great rapidity, but not far, quickly returning to the spot whence they took wing ; they delight in hot sunshine. The metamorphosis of *Stratiomys chameleo* has been often observed. The eggs are deposited on the underside of the leaves of the water plantain (*Alisma Plantago*) ; like those of the alder-fly, they are prettily arranged ; one egg partly covers another, like the tiles on a roof ; at first they are white, then green, then olive green. The larva is of singular form, elongated and without feet. At the extremity of the abdomen there is a spiracle surrounded with a coronet of hairs ; by this radiated extremity the larva often remains at the surface of the water, head downwards. These hairs can be closed up, so as to retain an air-bubble, which the larva, when it is has occasion to sink, carries down with it, and by which it again becomes buoyant when it wishes to

LARVA OF STRATIOMYS CHAMŒLEON (mag.)

ascend to the surface. The *Sargus cuprarius* (Plate IV., Fig. 14) is an insect of elegant shape and brilliant colouring; like the Soldier-flies, it inhabits flowers, bushes, etc., and is very fond of honey-dew; the body is bright green tinged with copper, the abdomen brassy green or bluish purple.

The *Tabanidæ* frequent woods in the summer; the best known species being the *T. bovinus* and *T. autumnalis* (Fig. 10); they are most frequent in hot summer weather; the males are harmless and frequent flowers, but the females pierce the skin of quadrupeds and feed on their blood; the long footless larva lives in the earth and feeds on decomposing matter. *Tabanus bovinus* must not be confused with another Brachycĕral-fly, viz., the *Oestrus bovis*, the female of which pierces the hides of cattle with her ovipositor, and lays therein her eggs. *Tabanus bovinus* passes through its metamorphosis under ground and not within the hides of cattle. It is, perhaps, the largest of the Dipterous insects, being nearly an inch long, and broad in proportion; the body is dark brown, thorax with several grey stripes, the abdomen has a row of whitish triangular spots. From the buzzing noise these flies make they have been called Breeze-flies. Sometimes they will attack men. Mr. Wood was once fiercely attacked by these Breeze-flies while rambling in the New Forset; their favourite point of attack was just behind the ear, into which they buried their sharp lancets, which pricked like sharp needles. On returning to his lodgings, after a few hours in the forest, he found the whole space behind his ears filled with clotted blood, his collar glued to his neck, and long tracks of blood running down his body and arms.

By rubbing paraffin over his hands, neck, and face, Mr. Wood subsequently found himself safe from their attacks.

The insects belonging to the *Xylophagidæ* are extremely rare and few; the larvæ, as the name of the family implies, live in decayed wood.

The *Asilidæ* are the most powerful and generally the largest of the Diptera; they are carnivorous in their habits, feeding on other insects, and may sometimes be seen flying away with some unlucky bee or beetle in the mouth. *Asilus crabroniformis* (Plate IV., Fig. 11), is a large conspicuous insect, marked yellow and black, which gives it a wasp-like appearance; it is generally distributed.

The flies of the family *Leptidæ* may be often seen in hedges and woods; one very common species may be found upon the trunks of trees or posts near the water-side; this is the *Leptis scolopacea*, the Oak-fly of the angler, sometimes called the Downhill-fly or Down-looker, from the habit the insect has of immediately turning its head downwards after settling on a tree. It is known to the fly-fisherman also by the name of the Woodcock-fly, the colour bearing some resemblance to that of this bird. The small feathers of the woodcock or grouse are used in making the artificial hackle-flies. A fly of the same family, and of somewhat similar appearance, is the *Atherix Ibis;* I have seen these flies congregating in thousands on rails across rivers, brooding over a mass of eggs, which they attach to boughs or other objects overhanging streams. The flies die soon after laying their eggs, others come and do the same, till large masses are formed as large as a man's fist.

Of the *Bombylidæ*, the most striking is the *Bombylius major* (Plate IV., Fig. 12), a furry-looking insect with nearly black body, which is thickly covered with hairs. It has a very long proboscis, almost equalling the length of its body, by means of which it sucks the nectar from flowers, like the Humming-bird Moth. The flight is rapid, flitting, and humming. Little I believe is known of the habits of the larvæ. Most of the Bombylidæ get their food from flowers; but in the genus *Thereva* some prey on other insects. Fig. 12 is slightly magnified.

The *Empidæ* are a very numerous family, the species being for the most part small and slender; some of the family, as the genus *Hilara*, may often be seen in swarms hovering over water, performing graceful evolutions in the air, now in circles, now horizontal or oblique; they are chiefly predaceous in their habits, feeding on the small Ephemeridæ or minute Diptera. The insect (*Empis livida*), a magnified figure of which will be seen on Pl. IV., Fig. 4, is useful to the farmer in devouring the Wheat Midge (*Cecidomyia tritici*); it is abundant in corn fields in June and July.

The *Dolichopidæ* are small flies, seldom exceeding three lines in length, often of metallic lustre; "they have a partial coating of tomentum in repelling water, which communicates a hoary gloss, particularly to the lower parts; this is composed of excessively minute, short, compressed, pellucid hairs, laid flat, and often so thickly set as overlap in several layers" (Ins. Brit., i., p. 145). Many species are found near water, on the surface of which they can run with great activity. The Dolichopidæ are all predaceous, feeding on small insects,

worms, and even small shell-fish. The family is a numerous one.

I pass over the families of *Lonchopteridæ*, *Platypezidæ*, and *Pipunculidæ*, as the species are not in any way remarkable.

The flies of the family *Syrphidæ* are very numerous; they feed chiefly on the nectar of flowers, over which they hover hawk-like; such is the rapidity of their vibration that the wings are almost invisible; if alarmed they dart away with amazing velocity, soon returning to the same place.

One species (*Syrphus pyrastri*) may be often seen in gardens; it is a blackish blue with pale hairs; on the abdomen are three interrupted yellow or whitish bands. The larvæ of the *Syrphidæ* are leech-like creatures in form, having generally a broad posterior extremity and a narrow flexible head; they are for the most part predaceous in their habits, feeding on the plant-lice or aphides. I have often seen a Syrphus larva holding on high in his mouth a mischievous little plant-louse, so that these flies must be put amongst the gardeners' and farmers' friends.

The species of the genus *Eristalis* are remarkable for the length of the tail in the larvæ. The perfect insects are of large size, and resemble bees both in form and colour, for which they are often mistaken. *Eristalis tenax* is, perhaps, the species most generally known. The larvæ or rat-tailed maggots live in stagnant water, in the filthiest of mud, and in sewers; the tail is a kind of telescopic tube, and contains a double air-channel, which is the respiratory organ; when the maggot is immersed in thick filthy mud the respiratory tail is ex-

tended to its fullest length to receive the necessary oxygen from the air. The larvæ of some of the Syrphidæ sometimes live in decayed trees.

The genus *Volucella* contains some large flies, and is remarkable for the fact that the species belonging to it select the nests of bees, wasps, or hornets, wherein they deposit their eggs. *Vollucella pellucens* (Plate IV., Fig. 9), is a common species, and may be recognised at once by the first segment of the abdomen, which is white and pellucid; it is a very swift-winged fly, and not very easily captured. The larvæ of *V. pellucens* are parasitic on those of wasps; the larvæ of *V. bombylans* on those of the bumble-bees; this latter fly is very similar to a bumble-bee, and no doubt is not recognised by the bees themselves as being a dangerous enemy to their young, or they would not allow it to enter their nest. "Did these intruders venture themselves among the bumble-bees in a less kindred form their lives would probably pay the forfeit of their presumption." (Kirby and Spence). This is quite true of *V. bombylans;* but there is no resemblauce between *V. pellucens* and any kind of wasp. The eggs are laid either in the cell which contains the wasp larva or on the top of the nest; the larva of *Volucella*, when hatched, eats its way into its victim, gradually intruding its whole body except the last segment, on which are the respiratory orifices, which thus come in contact with the external air.

The insects of the next family, the *Conopidæ*, frequent flowers, and their larvæ, like those of the preceding one, are parasitic on those of the bumble-bees. They are generally slender insects, about half-an-inch long, with the second abdominal segment more or less petiolated.

They form a small group, and several of the species are rare. *Conops rufipes* and *C. quadrifasciata* are generally distributed and common; the former has the second abdominal segment very attenuated, the posterior end thick; the abdomen of the other species is not very thin at the base. The flies of this family are prettily coloured, but not most gracefully formed.

The *Muscidæ* are, of all the various families of *Diptera*, the most remarkable, "on account of their very numerous groups, species, and individuals, of their extensive variation of structure, and of their great importance in the economy of nature; some species are insectivorous, many are parasitic in the larva state, the rest feed on living or decaying animal or vegetable matter" (Walker's Diptera). The species are divided into two groups:—

(1). Calypteræ, in which the alulæ or winglets are distinct.

(2). Acalypteræ, in which they are indistinct or absent.

The former are distinguished by their comparatively large size, compact, dark, or metallic bodies, and frequently by the development of the fourth and fifth joints of the antennæ or the basal joints of the arista. The insects of the latter group are comparatively small, with bodies less compact; their flight is more feeble, and the antennæ are less developed. Mr. Staveley remarks that in the habits of both larva and fly in the several groups of genera in this one family, there is nearly as much variety as in all the other families of Brachycĕra together. Thus while among the flies are found flower-lovers feeding on honey, blood-suckers,

flies preying on others, flies oviparous, and flies ovoviviparous; among the larvæ are found some terrestial and some aquatic, carrion-feeders, vegetarians, and wine-bibbers; parasites in the nests, and parasites in the bodies of other insects; gall-makers and leaf-miners. The common house-fly (*Musca domestica*), the flesh-fly (*Sarcophaga carnaria*), the blow-fly or blue-bottle (*Musca vomitoria*), the brilliantly-shining green-bottle (*M. chlora*), the yellow dung-fly (*Scatophaga stercoraria*), are all well-known species of the family of Muscidæ. Space is limited, so I must confine what I have to say almost to the flies just enumerated.

The larvæ of the House-fly are found in dung in stables, in the fields, and by the road-sides in great abundance; they are small footless grubs, slightly attenuated in front with a small head; the mouth is furnished with two retractile hooks, and at the posterior extremity there is a pair of stigmata for respiratory purposes. The pupa is enclosed within the skin of the larva. It is curious to notice the first appearance of the common domestic fly in public; his whole skin, on emerging from the pupa case, is soft and white; the wings are a thick opaque and wrinkled mass. After a few hours' exposure to the air and warm sun the creature is transformed into that "intrusive, buzzing, pilfering, boozing, tickling varlet," so annoying in the summer months, whose irritating behaviour is not stopped till the cold weather arrives:—

> "When his two pretty pinions of blue dusky gauze
> Are glued to his sides by the frost."

The Blue-bottle (*M. vomitoria*), so troublesome to housekeepers, more especially in hot sultry weather, by depositing its eggs (fly-blows) upon the joints of meat designed for the table, developes its pupæ in the same manner as does the domestic house-fly. The flesh-fly (*Sarcophaga*), with thorax and abdomen marked with rows of white stripes and spots, is viviparous in its mode of reproduction; the eggs, which are developed within the body of the parent, are very large; they are arranged in a spiral form, resembling two white rows of ribbon. Réaumur calculated that one fly would produce 20,000 maggots; it was this species to which Linneus referred when he said that these flies could eat an ox as fast as a lion could! These all belong to the division of Calytera.

The remaining fly (*Scatophaga stercoraria*), the Cow-dung-fly, belongs to the second division. Let no one despise this bright, active, yellow insect, which acts as a useful scavenger in removing offensive matter. Your approaching footsteps drives the living cluster all of a sudden away "with mighty buzz and bustle," quickly however to return on your departure from the spot. The eggs of the Cow-dung-fly are deposited on the dung on which the larvæ feed. Réaumur found that the eggs required to be immersed in the moist dung; that if they were not thus surrounded with moisture they shrivelled up and came to nothing; it was equally necessary that the eggs should not be wholly covered, otherwise the young larvæ would be suffocated at their first exit from the egg. In what way is this nice point secured? In this manner. Each egg is provided, near its upper end, at which the animal when

hatched comes out, with two diverging horns, which prevents its total immersion in the dung. Hundreds of these eggs may be seen in a summer's days in cow-dung, looking like little white specs. The French Naturalist compared them to a parcel of cloves stuck into a pudding! When the larvæ are ready for hatching the egg case opens at the upper end and the young maggot escapes. The genus *Scatophaga* contains several species; besides excremental food they prey also on other two-winged insects.

On Plate IV., Fig. 3, is a magnified figure of *Tephritis* (*Trypeta*) *Heraclei*, another insect of the family of *Muscidæ*. The insects of this group are lively flies, and may be not unfrequently seen fluttering over leaves in the hot sunshine, and vibrating their prettily-spotted wings, which are carried erect, like those of butterflies. The species figured lays her eggs within the cuticle of celery and parsnip leaves, there they hatch and produce little transparent maggots, causing large blisters upon them. All growers of carrots are aware how often the roots are pierced with many holes, which contain small maggots, producing the disease called *rust;* the little creatures' tails may often be seen protruding; the enemy that hath done this is one of the Muscidæ, viz., the *Psila Rosæ* (Fig. 2), a name given to the insect by Fabricius, who probably first found it sunning itself on rose trees; *Psila dauci* would be a more suitable name. The insect is not more than three lines long. Curtis recommends, as a great security against the attacks of these insects, a dressing of spirits of tar and sand, to be put on the ground before sowing the carrots; the scent of the spirits of

tar is so offensive to insects that they cannot endure soil impregnated with its odour.

Bot-Fly (*Æstrus bovis*) magnified.

The family of *Æstridæ* contains those insects which, in their larval state, are well known under the name of *Bots*, *Wurmals*, etc. These insects (*Æ. bovis*) deposit their eggs on cattle, in whose bodies the larvæ are nourished. The presence of the fly is soon felt amongst the herd of cattle ; with tails turned upon their backs or stretched stiffly out in the direction of the spine, off they gallop about their pastures in the wildest state of terror. An allied fly (*Æstrus ovis*) (Fig. 13), infests sheep, laying its eggs within the nostrils, from whence the maggots make their way into the head, feeding on the mucilage produced in the maxillary and frontal sinuses. When ready to assume the pupa stage they fall to the ground

and become pupæ. These larvæ do not make their way to the brain and cause the death of the poor sheep, as is often asserted. Sheep may often be seen in hot weather shaking their heads and holding their noses close to the ground in dry dusty spots, in order to prevent the gad-fly entering the nostrils.

The Horse Bot-fly (*Gasterophilus equi*) deposits its eggs on the hairs of such parts of the body as the horse can reach with its tongue; these parts being licked by the horse, the attached eggs—little yellow specs, familiar to all—are conveyed to the stomach, where the larvæ are developed; when full grown the larva detaches itself and discharged by the horse falls to the ground, where the final changes are undergone. It is curious to see this Bot-fly in the act of laying its eggs on the horse's skin; it will remain for a few seconds opposite a spot in the horse, hawk-like—the wings vibrating with amazing rapidity—and then, with its pointed abdomen, affix an egg to the hair; then the process will be repeated.

The sub-section—Hypocera—in which the antennæ are situated low down near the mouth, consists of the genus *Phora* only, which contains a few minute flies, which need not detain us at all.

The Eproboscidea, the second section of the Diptera, contain insects which are parasitic in various quadrupeds and birds, such as the Forest-fly (*Hippobosca*), the Sheep-tick (*Melophagus ovinus*), the Bird-tick (*Ornithomyia avicularia*), the Swallow-tick (*Stenopterix Hirundinis*), and the Bat-tick (*Nycteribia*).

THE HYMENOPTERA.

In the Order Hymenoptera we find a number of insects, remarkable not only for beautiful modifications of structure, but for the possession of highly developed instinct and reasoning powers. Many are excellent architects, and build dwellings marvellously contrived. They are especially fond of their young, which they watch over, and feed and rear with the utmost solicitude. They form governments, carry on systematic wars, capture slaves whom they constrain to work for the good of the body politic, and are remarkable for their social qualities. The order has just claims to occupy the first rank amongst the other orders of the Insect world.

The Bee, Wasp, Ant, Ichneumon, and Gall-fly belong to this order, and they have attracted the attention of man from very remote periods. The wings are always four in number; the abdomen of the females is furnished either with an ovipositor in the shape of a saw or an auger, or with a venomous sting. All undergo complete metamorphosis: the larvæ, in most cases, are footless grubs, and live in cells provided for them; they are for the most part dependent on the food supplied to them by their parents; but the Saw-flies exhibit striking differences, their larvæ, being provided with legs like those of the Lepidoptera, are able from earliest infancy to procure their own food.

The Hymenoptera are divided into two sections, viz., the Terebrantia and the Aculeata. In the former the

HYMENOPTERA.

females possess an ovipositor in the form of a saw or auger, hence the term, from *terebra*, "a borer;" in the latter the females are provided with a venomous sting. The Terebrantia are again divided into two sub-sections, the *Phytophaga*, because the larvæ feed on plants, and the *Entomophaga*, whose larvæ (with the exception of those of the gall-flies) feed on other insects. In the Plant-eating Borers and Saw-flies the abdomen sessile, that is, attached to the thorax by its whole width; in the Insect-eaters the abdomen is attached to the thorax by stalk of short or extended length. The instrument by means of which the Saw-fly (*Tenthredo*) forms a depression in a branch or leaf, or notch for the attachment of her eggs, consists of a double serrated auger, the teeth of the saw being themselves toothed. "The perfection of this minute weapon," Professor Duncan observes, "suggests that manufacturers might take a lesson from it, and invent a cutting saw with double serrations, which might be of infinite use in the arts." The Saw-flies larvæ are éminently destructive in gardens and turnip fields, causing very serious losses at times.

The Gooseberry-leaf eater must be familiar—at least, its damages must—to all who have strolled in the kitchen garden. The eggs, little white specks, are placed down the mid-rib of the leaf, and the hatched larvæ begin their devastations at once, in a short time eating the whole of the leaf, with perhaps the exception of the thick parts of the mid-rib. I have just brought in two larvæ of the Gooseberry Saw-fly (*Nematus grossulariæ*) from the garden; the bush is stript absolutely bare of leaves. The larva might at first be

taken for that of some Lepidopterous insect, for it has six true legs, a number of abdominal or false legs, and one pair at the tail; but it can be readily distinguished. A Lepidopterous larva has never more than four pairs of abdominal legs; the Saw-fly larva may have five or six pairs or more. The number of these abdominal legs on the larva of the Gooseberry Saw-fly is six pairs. The grub is of a dark green—the colour of the gooseberry leaf—spotted with black, and beset with short hairs; the head is deep black, and so are the true legs; towards the head and tail end the colour is of a yellowish tint. Hand picking is the best remedy. The drawing of the insect on Plate V., Fig. 7, is the Turnip Saw-fly (*Athalia Spinarum*) considerably magnified; the larvæ, called "niggers" in some counties, feed on the leaves of the turnip, which they reduce to mere skeletons of fibres. These flies come over from the north of Europe, according to Curtis, but are probably bred in small numbers annually in this country. Mr. F. Smith, the eminent entomologist of the British Museum, once encountered a multitudinous host of these Saw-flies on the sand hills near Deal, towards the end of August. "I pursued my way," he says, "penetrating into the cloud of insects, which, when observed from a position in which I faced the sun, assumed a tint approaching vermilion red. The insect-clouds were borne seaward by a gentle south land breeze. I plunged into the water, and hoped by swimming from the shore to free myself from their annoyance, but finding that at a distance of not less than three hundred yards the surface of the sea was thickly covered with them, and as far as I could see that they floated in equal numbers,

I hastened to shore, and as quickly as I could made my way to the West of the hills, when I found myself freed from their annoyance. Every blade of grass, every rush and twig was thickly studded with the flies, and was bending with their accumulated numbers. The majority of the insects I observed were females."*

The larvæ of the Gooseberry Saw-fly are said to undergo their transformations in society, one attaching the end of its cocoon to the end of the next. The whole family of Tenthredinæ is eminently destructive; the larvæ have the habit of rolling themselves up spirally when disturbed. Before passing into the pupa state the creatures form for themselves a silk-lined cell in the ground, or they burrow into the pith of plants, or attach a long oblong cocoon to the surface of a thorn branch.

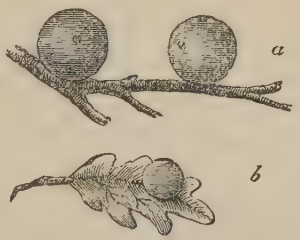
As an instance of the Boring Terebrants I select the large hornet-like insects, not very uncommon in England, though it is believed not breeding here. This is the Fir-wood-borer (*Sirex gigas*), of which a figure of the natural size will be found on Plate V., Fig. 9. The formidable appearance of this insect—the female of which has a long ovipositor, supposed by the uninitiated to be a sting—its great size and conspicuous colouring, have rendered it an object of alarm. I once received a specimen from an acquaintance, who assured me that a number of these insects attacked and stung his carriage horses as he was driving out, and wished to know what the horse-stinger could be. A few of these large insects approaching horses with a loud humming, would very

* Staveley's Brit. Insects, p. 160.

probably alarm them and cause them to become restive; but the tail filament is not a stinging organ but an ovipositor, of curious structure, by means of which the female drills a hole in the wood, usually fir, into which she deposits her eggs, from which are developed blind grubs with six true legs, all the abdominal ones being absent. These larvæ often cause great damage in pine forests—the wood of which they intersect by their burrows—but they are also found on other trees, as on the hornbeam and willow. It is supposed that British specimens have been introduced in the larva or pupa state in foreign timber. Another large species of *Sirex* —or *Urocerus* (Horn-tail) as the genus is now often called—the *S. juvencus* is sometimes found in this country. The male is yellow and black, but the female is dark black with a violet tinge. On one or two occasions this species has been sent to me.

The sub-section, *Entomophaga*, contains the Ichneumons, Ruby-tails, and Gall-flies; though these latter are not insect eaters—for they feed on the juices of the gall—they are generally placed in this division, because in other respects they have their affinities with the other insects of the sub-section. All the insects of the insect-eating Borers, excepting some of the Gall-flies, are parasitic, some depositing their eggs within the bodies of other insects or insect-larvæ, where they hatch, develope, and feed on the fat or juices of their doomed hosts, others placing their eggs in the nests of other insects, where the larvæ either consume provisions destined for others, or where food has already been stored by the parent insect. This sub-section, Entomophaga, contains two divisions, viz., the Dart-bearers.

Spiculiferæ, and the Tube-bearers, *Tubuliferæ;* the former consists of Gall-flies (*Cynipidæ*), the Ichneumons (*Ichneumonidæ*), the *Evaniidæ*, *Chalcididæ*, and the *Proctotrupidæ;* the latter the Ruby-tails (*Chrysididæ*). The Dart-bearers are parasitic on living insects, the Tube-bearers are supposed to be parasitic in the nests of other Hymenopterous insects. The Gall-flies are the authors of the oak-apples, so much sought after by school-boys on the 29th of May (King Charles II. day); the currant-like balls on the long catkins of the oak, and the round, hard, smooth, marble-like galls, not known in this country some thirty years ago, but exceedingly common now on young oak trees. The insect which produces this last named gall is the *Cynips lignicola*, so called from the hard woody structure of the gall; by some entomologists it is called the *Cynips Kollari*, after a German naturalist. I first noticed this gall in Devonshire about the year 1858; I had not noticed it in Warwickshire where I was then living, nor did I see it in Shropshire till about the year 1862. Now it is common in every field and hedgerow. In the gall of the *Cynips Kollari*, generally within the very centre will be found at the proper season of the year a single white grub, snugly hid in its dark recess; on assuming its perfect stage, the little insect gnaws its way out into the world of light. The small round holes that may be seen on the surface of the gall,



a. Gall Nuts.
b. Gall Nuts of *Cynips Quercus folii.*

announce that the insect has made its escape. The gall-nuts of commerce which grow on the *Quercus infectoria* in the Levant, are employed in making ink. It was at first supposed that the oak galls of the Cynips Kollari were identical with the gall of commerce, but it is properly recognised now as a distinct species.

The large oak "apples" give birth not to one individual only, but to a multitude. Those small circular flattened scales—often of a pretty pink hue, hairy on the upper surface, but smooth underneath—that you may see to cover the under side of oak leaves in great abundance, commonly called oak spangles, are the produce of the little Gall-insect, the *Cynips Longipennis* (Fab.), which makes its appearance long after the leaves have fallen in the month of March.

The oak-apple galls are produced by *Cynips terminalis;* a large woody gall found on the roots of oak trees, is produced by *Cynips aptera.* The spongy or rather mossy substance, often of a brilliant crimson, common on the wild rose, is the produce of a Cynips. The ovipositor of the Gall-fly has a toothed edge at the extremity, which moved by the muscles of the insect, act as a miniature saw, which penetrates the leaves or stalks of the trees infested by the particular species; the egg is deposited in the hole made by the little auger, together with it is supposed a drop of fluid which has a peculiar irritating effect upon the vegetable tissues; but why, in one case, the result should show itself in the form of a flattened circular disc, in another in that of a furry ball of moss, in another in

that of a small artichoke, etc. etc., one cannot say. The problem still remains to puzzle us.

The Naturalist after collecting a number of galls, for the purpose of discovering the various kinds of Gall-fly inhabited by them, cannot be sure that the little insect he sees to emerge from its place of concealment, is the original and lawful occupant, for there are various kinds of Ichneumon flies, which in their turn pierce the body of the young Gall-grub wherein they deposit an egg, from which is produced a parasitic Ichneumon, which feeds on the young Gall-grub, and eventually comes forth from the same hiding place. The Gall-flies are small insects, the largest species known in England being the *Cynips Kollari*, already noticed.

I ought to notice that both in the Saw-flies and the Gall-flies the males seem very rare. Mr. F. Smith once collected about a bushel-and-a-half of the galls of *C. Kollari*, for the purpose of finding a male. None but females made their appearance. Yet when he placed the female flies in various places, on oak trees, and visited them afterwards he found new galls on those trees, but on no others in the neighbourhood. Here is an instance of parthenogenesis, evidence of the existence of which in the Cynipidæ has lately been commented upon by Siebold, who has also considered the fact of the rarity of the male. Many species of the Tenthredinæ (Saw-flies) exhibit the same phenomenon.

The *Evaniidæ* are most extraordinary looking insects; the family contains only a few species, which are parasites on cock-roaches (Blattæ). *Evania appendigaster* has an enormously developed thorax, and

an excessively small abdomen, which appears to spring from the upper surface of the thorax, instead of from the apex, the usual point of attachment.

The family of the *Ichneumonidæ* is very numerous, and contains insects both large and excessively minute. They are all parasitic on other insects, and in many cases are eminently useful, as active agents in the destruction of the numerous pests of the garden and farm. The name of Ichneumon, originally given to the carnivorous animal (Herpestes) of Egypt, because it "tracked" or hunted afar the eggs of the crocodile, became applied to the Hymenopterous insect, from its habit of hunting for caterpillars, plant-lice, etc. These insects are distinguished by having the abdomen attached to the thorax at its hinder extremity, and between the base of the hind-legs, and often by a pedicel; the antennæ are long and elegant; the ovipositor is in some species external and of great length, in others it is short and concealed within the abdomen; these structural differences intimate a difference of habit, for while some species deposit their eggs upon exposed larvæ, others guided by some mysterious instinct, discover the habitat of some concealed grub, and by means of their long sting-like ovipositors, succeed in piercing through the concealing substance, and lodging their eggs within the body of their victim. The little Gall-fly grub may fancy itself snug and safe within the large oak-apple, but the Ichneumon fly can reach him; neither is the wild bee secure within its cell, nor the beetle in its wooden retreat within the branch of some forest tree. There is scarcely a tribe of insects which is not subject to the attacks of these

parasites, but perhaps the Lepidoptera are the most common victims. Their ravages amongst the *Hemiptera*, as the aphides, are also very considerable; and even the spider, the fly's deadly enemy, is itself subject to the attacks of the Ichneumon. The Cabbage-eating grubs—the larvæ of the white butterflies—are often inhabited by a host of minute Ichneumon larvæ (*Microgaster glomeratus*); were it not for these little parasites, hardly a cabbage could be saved. After the Microgasters have consumed as much of the caterpillar as they wish, they pierce through its skin and form cocoons, leaving the victims to die. Their little yellow silk-cocoons are miniature likenesses of those of the silk-worm, and must be familiar to many who, perhaps, do not know what they are. They appear as clusters attached to walls, posts, etc., containing perhaps a hundred or more cocoons. I must not forget to mention that the Ichneumon larvæ infesting the bodies of caterpillars, feed only on the fatty matter of their victims, carefully avoiding the vital organs till they are ready to assume the pupa state. Some of the larger perfect insects are most interesting to watch; they seem so bold, active, and intelligent, with their large bright prominent eyes, and their long elegant antennæ, which they keep constantly moving about, leading one to believe that they must be organs of great importance. The perfect insects are not, as a rule, carnivorous in their habits, but feed on the nectar of flowers, and the honey dew found on the surface of leaves. They are active fliers.

The *Chalcididæ* contains a great number of species, generally of a very small size, and of splendid metallic

lustre. The wings have few veins, in some species they are absent. In some genera the femur of the hind-legs is enormously swollen, and sometimes internally serrated; this thickening does not, however, as we might be inclined to think, indicate leaping powers. These insects are all parasitic upon others, chiefly in their larva and pupa states; some lay their eggs even within the eggs of other insects, and the larvæ are nourished therein, which may give us some idea of their minute size.

The *Proctotrupidæ*, like the preceding family, contains insects of very small size. A species of *Platygaster* is useful in checking the injury done to wheat by the two-winged insect, the *Cecidomyia tritici*. There are about four hundred British species in this family.

We now come to the division of the *Tubuliferæ*, so called from the structure of the abdomen, the end of which is retractile like a telescope. The Ruby-tails (*Chrysidæ*) alone constitute this family, of which the common *Chrysis ignita* (Plate V., Fig. 6) is a good representative. The brilliant colouring of this insect, with its head and thorax of metallic blue or green, and abdomen of crimson or fiery copper, has won it the name of the humming bird amongst insects. The Chrysis is parasitic in its habits, depositing its eggs within the cells of other Hymenopterous insects. The subject of the parasitism of the Chrysides has recently been investigated by Dr. Chapman (of Borghill, Hereford), who in conjunction with Mr. Steele of Abergaveny, has published in the transactions of the Woolhope Naturalists' Field Club, some very valuable

papers on this and kindred subjects. I regret I have not space to quote much of Dr. Chapman's well-narrated words, but must content myself with a short summary.

Chrysis ignita, the most abundant of the family, will lay her eggs in the nest of almost any kind of Wasp or Bee, to which she can obtain access. Occasionally she will visit the burrows of *Odynerus Spinipes* (one of the Mason Wasps). Two other species of Ruby-tails, viz., *Chrysis neglecta* and *C. bidentata*, are specially attached to this Mason Wasp, and apparently to no other; these two Ruby-tails are common where the Mason Wasp abounds. The nest of another Mason Wasp (*Odynerus parietum*) was seen to be visited by the *Chrysis ignita;* the narration is as follows:—"On July 17th, I observed a nest of *O. parietum* with one cell open, containing a nearly complete supply of lepidopterous larvæ. A *Chrysis ignita*, flying about, settled beside the cell, and after a brief examination with her antennæ, wheeled round, and introducing her abdomen into the cell, rested for about twenty seconds, doubtless, in the act of oviposition. I now regret that I did not then examine the contents of the cell, in order to ascertain the fate of *Odynerus parietum's* egg. Three-quarters of an hour later, *O. parietum* had closed the cell with the usual earthen pellets. I examined this cell on the 19th, two days after, when I found a larva of *C. ignita* a quarter of an inch long, together with several of the lepidopterous larvæ stored by the Wasp, but found no trace of either egg or larva of the latter. On the 23rd, six days from the date of oviposition, the Chrysis larva had eaten all the store, and was full fed. I obtained

evidence of its having cast its skin three times whilst under observation, and from the analogy of *C. bidentata*, I believe it had done so four times altogether. The stored larvæ had all been devoured, their heads alone remaining, just as when eaten by the Wasp grub. The larva then spun a cocoon, which I knew to be typical of *C. ignita*. The rapidity with which it had fed up was extraordinary. None of my *neglecta* or *bidentata* fed up so rapidly; but the warm sunny wall on which *parietum* had built her nest may partly account for this, my larvæ of the other two species having been kept comparatively cool."

The deposition of the eggs by these insect Cuckoos is not always allowed to take place by the rightful occupants of the cells without a contest. Westwood tells us, on the authority of a French Naturalist, an instance in which a Mason Bee, returning to its nearly finished cell, laden with pollen paste, found a *Hedychrum* (one of the Chrysididæ) in its nest, and attacked it with its jaws: the parasite immediately rolled itself into a ball, so that the Bee could not hurt it; however, it bit off its four wings which were exposed, rolled it to the ground, and then deposited its load in the cell and flew away, whereupon the Hedychrum, now wingless, had the persevering instinct to crawl up the wall to the nest, and there quietly deposit its egg, which it placed between the pollen paste and the wall of the cell, which prevented the Mason Bee from seeing it.

The Aculeate Hymenoptera are those insects which are furnished with a sting, which is connected with a poison gland; Ants, Wasps, and Bees are well-known representatives of this section. This section is divided

into two sub-sections, viz. : (1) The *Prædones*, the Robbing or Rapacious, and (2) the *Anthophila*, or flower-loving Hymenoptera. In the former these are Ants, Sand-wasps, and Wasps, in the latter Bees.

In the Prædones there are the following divisions :— (1) *Heterogyna*, which contains the Ants. (2) *Fossores* which contains the Sand-wasps. (3) *Diploptera*, containing the true Wasps.

There is a distinguishing mark between these two sub-sections, in the shape of the hind-leg, the first joint n the tarsus is cylindrical in the Prædones, enlarged and flattened in the Anthophila.

Heterogyna are divided into the *Formicidæ*, the Social Ants, and the *Mutillidæ* or Solitary Ants. The economy of the Heterogyna is varied, some form tunnels and burrows under the ground, others in decaying trees, some suspend their nests from trees. The societies consist of males, females, and workers, these latter being probably abortive females. The males are always winged, the females only for a time. Small as are most of the species of British Ants, their economy is truly marvellous, even amid the many marvels of the insect world. "The industry of the Ant," to quote the words of Mr. F. Smith, "is a household proverb ; when their habitations are by any means injured or destroyed, no time is lost in useless despair—one spirit animates each individual—simultaneously they set to work to repair their misfortune—unceasingly they labour—nothing damps their ardour or abates their industry—until as if by magic hand, their habitation again rises to its former height and beauty, and all trace of ruin has disappeared." The Social Ants are distinguished

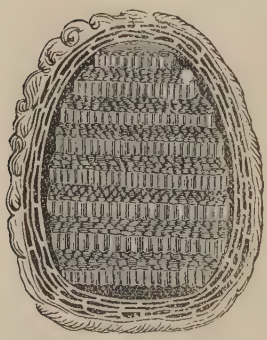
from all other hymenopterous insects, by the formation of the first or first and second joint of the abdomen, the stalk by which the abdomen is attached to the thorax; in some families the first joint grows out into a raised kind of scale; in the Myrmecidæ the first and second joints are similarly formed. The females of the Social Ants retain their wings only for a time; after associating in the air and sunshine the males die, and the females descending to the earth, prepare for underground work, by stripping or biting off their wings; they then enter the chambers prepared by the neuters and lay their eggs. The tenderness and anxiety manifested by the ants towards the young are wonderful, and must have been witnessed by any one who has ever consciously or unconsciously disturbed an Ants' nest. How full of commotion is the busy scene, as the little creatures hurry off with the large white pupæ, larger than themselves! But besides the neuters and females, other occupants are found within Ants' nests, amongst them the Aphides, which are kept prisoners by the Ants, who are fond of the sweet fluid secreted by these Plant-lice. Beetles are also found in Ants' nests; only yesterday I found three large ground Beetles quietly ensconced in an Ant's nest, but whether they were there as voluntary guests or detained prisoners I cannot say. After the eggs are laid by the females they are watched with great care by the neuters, who, according to the observations of the Swiss Naturalist Huber, daily remove them to different parts of the nest where the temperature is most suitable; after the eggs are hatched the larvæ receive the most constant attention from the neuters, who feed them with honey-dew and other sweet

fluids, elaborated in their stomach and then disgorged. But I have no time to tell the hundredth part of Ant-lore; how some species, as *Formica Sanguinea*, invade the nests of others and plunder them of their pupæ, which they carry off to their own colonies and bring up as slaves, how they milk the Plant-lice which they imprison in their nests, how when they become too numerous the surplus population emigrates, how the new colony uses all sorts of devices to induce other ants to join them; nor can I do more than refer to the bull-dog courage sometimes exhibited, as when an ant has attached itself to some large beetle and chosen to die there rather than relax its hold! It is said that in Switzerland ants are crushed into a plaster, and applied to the head as a cure for the headache, and that Swiss school girls rub their foreheads with the insects, "*pour se fortifier la mémoire.*" Formic acid ant-baths are also used in Switzerland and Germany, according to Mr. Staveley. A Russian lady at Wildbad was ordered to visit a village in the Black Forest, to strengthen herself by the use of ant-baths; and a child, four years old, "who had dwindled away to a mere skeleton," is said to have had her strength completely restored by a course of ant baths. The ants are the large Wood-ants which are collected with earth leaves, etc., and placed in bags, and hot water poured on them; they are left for a time and the bath is ready for use. Then ant baths are said to be used at Wiesbaden, but I have been unable to learn anything about them from a friend who has just returned from a few weeks' sojourn there.

The Solitary-ants (*Mutillidæ*) are not much known in this country; the females are wingless. *Mutilla*

Europæa is one of the largest species ; they are supposed to be parasitic in the nests of other insects.

The Fossores or Diggers consist of the Sand-wasps and Wood-wasps ; they are solitary in their habits, and excavate cells in wood or earth, in which they bury other insects which they have captured, and disabled by stinging them. The eggs are deposited in the cells, and the larvæ, when hatched, find food ready at hand.



Nest of Wasp (interior .

Nest of Wasp (exterior

Sometimes dead insects are stored in the cells. In Plate V., Fig. 8, will be seen a drawing of a Sand-wasp (*Ammophila sabulosa*), somewhat magnified.

The *Diploptera* or True-wasps consists of the Solitary-wasps (*Eumenidæ*), and the Social-wasps (*Vespidæ*) ; the former live isolated and consist only of males and females ; the genus Eumenes is the type ; there is only one Britsh species (*E. coarctata*) ; this insect forms a nest of mud or fine earth of spherical shape, which it

attaches to the stems of plants such as heath. After filling the nest with young caterpillars the female lays an egg therein and closes the mouth of the nest. When the young larva is hatched it feeds on the contents, and when ready to emerge it eats its way out of the nest through the side.

Other kinds, as in the insects of the genus *Odynerus*, form burrows in sandbanks, in which they construct their cells, which are often built of mud; in these cells young caterpillars are placed and the eggs then laid.

The family of *Vespidæ* contains the Social-wasps, which are divided into Tree-wasps and Ground-wasps; these consist of males, females, and neuters. The Tree-wasps attach their nests to the branches of trees and woodwork of outhouses; but their habits are not invariable, for the Ground-wasps sometimes suspend their nest in the roofs of houses.

There are seven British species of Wasp, of which the Hornet (*Vespa crabo*) is the largest and most formidable. The societies of Wasps are annual; all die excepting the females, which are all able to survive the cold of winter, and ready at the return of spring to become the parents of thousands. In Plate V., Fig. 1, is the Hornet; Fig. 2, the Common Wasp; and Fig. 3, one of the Tree-wasps (*V. sylvestris*).

The sub-section, *Anthophila* (flower-lovers), contains the Short-tongued Bees and the Long-tongued Bees; the former, consisting of the family of Andrenidæ, are solitary; only perfect sexes are known in the two genera of this family. *Colletes* burrows in sandbanks and sandstone, and plasters the inside of the burrow—which is a tubular cell six to ten inches long—with a

thin coating, like goldbeaters' skin, of some substance secreted by itself, which is laid on in a fluid state by the little biloped tongue. A mixture of pollen and honey is laid in the cells, formed by the little bee, and the eggs deposited in the cells. These insects are very common in dry sandy banks.

Leaf-cutting Bee (*Megachile centuncularis*).

I have not space to dwell longer on this most interesting Order of Hymenoptera, and must pass over the Cockoo Bees, which, as their name implies, make use of the nests of other species, and the Humble Bees, and the Hive Bees, and content myself with a few words

on the Leaf-cutting Bees (*Megachilidæ*), whose operations I have recently been witnessing. These bees bite off portions of rose leaves from the edges, of an oblong shape, and about half-an-inch long and a little more than one quarter-of-an-inch broad; each green piece of wild-rose leaf, when cut off, is carried by the bee's hind-legs into the hole of a sandbank where she is forming her nest; after depositing this, she comes out of the hole and flies rapidly off, returning again after the interval of a few minutes with another bit of wild-rose leaf of precisely the same pattern as the last; this she conveys into the hole, where she remains for a few minutes and then again appears and repeats the operation. I watched one of these Leaf-cutters for about an hour one warm day in the month of June, and then left without having disturbed her. I returned to the same spot four days afterwards, and as I could see nothing of them, I concluded the cells were completed and the bee's labours terminated. On examining the hole I found two green thimble-shaped objects formed of leaves. One I opened and examined; the other lies before me as I write. The leaves forming the length of the cell are oblong; there are four or five layers of them, forming a cylindrical tube; the open end of this tube is, of course, circular, and the bee here has seen that to close a circular opening a circular door is necessary, and has accordingly altered her pattern from the oblong to the circular, and has cut out three or four perfectly circular bits of rose leaf, with which she has closed the opening! What marvellous intelligence! The inside of the cell is full of a dark yellow paste, a conserve of pollen and honey, and at the end is a

single egg which, after becoming a larva, will find a store of food ready for use. The ant is set before us in the Bible as an example of diligence and patience. The Greek translation in Prov. vi. 8 has the following eulogium on the bee: "Go to the bee and learn how diligent she is, and what a noble work she produces, whose labours kings and private men use for their health; she is desired and honoured by all, and though weak in strength, yet since she values wisdom, she prevails." This passage is not found in any Hebrew copy of the Scriptures; it exists, however, in the Arabic version, and is quoted by Origen, Clemens Alexandrinus, Jerome, and other ancient writers.

COLEOPTERA.

We now come to the Beetles or Sheath-winged insects, whose first pair of wings are more or less of a horny consistence, and form a covering for the posterior pair when not in use. These sheaths, when the beetle is flying, are extended motionless at right angles to the body, and when the insect is at rest they generally meet in a straight line down the back. The metamorphosis in the Coleoptera is as complete as in the Hymenoptera and Lepidoptera; the larvæ are generally soft fleshy grubs, though, in some cases, the integuments are leathery and tough; they have generally six legs on the thorax, and frequently anal-pro-legs. The pupæ are free and inactive. This order contains an immense number of species; the British species numbering about 3,000, and to this additions are made from time to

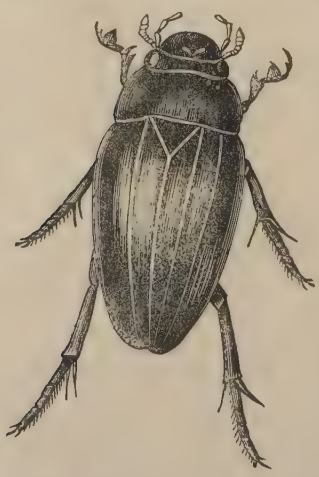
COLEOPTERA.

time. The Coleoptera are divided into four large sections, characterised by the number of joints in the tarsi, although the character is liable to many exceptions. The largest section contains such beetles as have five joints in the tarsi; these form the *Pentamera*. In the second group, the *Heteromera*, most of the insects have five joints in the tarsi of the two first pair of legs, and four joints in the tarsi of the hinder pair. In the *Tetramera* the tarsi are usually four-jointed; in the *Trimera* three-jointed.

The Pentamerous-beetles are divided into four sub-sections: the *Adephaga* (Ravenous beetles), *Rhypophaga* (Filth-eaters), *Cordylocerata* (Club-horns), and the *Prioceratа* (Saw-horns). The Ravenous-beetles live some on the land, others on the water; of the land ravenous-beetles the Tiger-beetle (*Cicindela campestris*) may be taken as a sample. It is an extremely active insect of bright green colour, with crimson and gold, and several cream-coloured spots on the wing-cases or *elytra*—see Plate VI., Fig. 1. It frequents dry sandy banks, and is fond of the sunshine. The Tiger-beetle has the character of being extremely ferocious; in captivity these insects will "fight savagely, rearing up against one another like dogs, decapitating their adversaries by single strokes of the jaws." The female has been

WATER-BEETLE (*Dyticus*).

seen to kill and eat her husband. Of the Water Adephaga, the common Dyticus, or great Water-beetle, may be taken as an illustration; this insect, which is common in ponds and ditches, is also a fierce creature, both in its larval and perfect stages; the larva is of shrimp-like form, and is furnished with long curved mandibles, which are perforated; through these tubes the creature sucks the juices of its victims. The beetle is of large size, attaining a length of about an inch or more. The little whirl-gigs (*Gyrini*), which love to skate in circles on the surface of the water, belong to this tribe. The Rhypophaga or Dirt-eaters contain the large Water-beetle *Hydröus piceus*, which exceeds the Dyticus in size, the Burying-beetles, the Devil's Coach-horses, etc. The Hydröus is not nearly so common as the Dyticus, and I do not remember to have ever found it in Shropshire; in its perfect state it is a harmless insect, but as a larva it is fierce and voracious. The female beetle makes a pear-shaped flexible bag of silk, in which she encloses her eggs; the sac is attached to some water weed. The Burying-beetles (*Necrophorus*) are so called from their habit of burying small animals or pieces of carrion, which they do by digging the earth from under



HYDROUS PICEUS (natural size).

them ; this being done the female deposits her eggs in the carrion, which supplies food for the larvæ. It is recorded that in fifty days four beetles buried four frogs, three small birds, two fishes, one mole, two grasshoppers, the entrails of a fish, and two pieces of ox liver ; so that they may be looked upon as useful scavengers. The insects of the genus Necrophorus are of rather a large size, and are often adorned with orange-coloured bands. The woodcut represents the *N. mortuorum,* Sexton or Burying-beetle.

Burying-Beetle.

The Devil's Coach-horse must be familiar by sight to everyone ; it is a long black creature, which has the habit of turning up the tail and opening its jaws in a most threatening way when disturbed. The elytra or wing-cases are remarkably short ; hence they belong to sub-division called Brache-lytra (Short-Elytra). They are active, voracious feeders, of an elongated form ; reminding one, at first sight, of a large black earwig, only the tail is not provided with a forceps. The scientific name of this beetle is *Goerius olens ;* the first word being the Greek word, meaning "mournful," on account of the black sombre colouring ; but *Ocypus* ("swift-footed") is adopted by some Entomologists ; *olens* refers to the fœtid emanations from the tail tubercles.

The large Stag-beetle (Plate VI., Fig. 8,) belongs to the sub-section *Cordylocerata,* and sub-division *Lamellicornes.* The stag-like horns are the mandibles, which in the male are enormously enlarged. The Stag-horn

(*Lucanus cervus*) is the largest of the British Beetles, being nearly three inches long, though there is great variation in this respect, some males being not half the size of others; these have comparatively weak jaws. The larva lives in rotten wood, such as the oak and the willow, and continues in that state for four years or more; then spinning a cocoon out of the wood chips with which it is surrounded, it enters on its pupal stage. The Stag-beetle feeds on the juices of plants, which it obtains by bruising, with its strong jaws, the twigs and fruit of trees; it can bite severely, and it is said the jaws can retain that power after the head has been severed from the body. It is common in some parts of the South of England, but does not occur in Shropshire. The common Dung-beetle (*Geotrupes stercorarius*), that "wheels his droning flight," and occasionally comes in contact with your face, belongs to the *Lamellicornes* or beetles with leaf-like antennæ; as does also the Cock-chafer or May-bug, and the Rose-beetle (*Cetonia aurata*). This latter insect, of a bright shining green colour glossed with gold above, and polished copper beneath, is not unfrequently found in roses; it occurs also in other flowers, as elder flowers and thistle flowers (Plate VI., Fig. 3).

In the sub-section, *Priocerata*, the antennæ are generally serrated or toothed like a saw; hence the Greek word. Skip-jack beetles, Glow-worms, the long Soft-bodied-beetles, popularly called "soldiers and sailors," belong to this division. The Skip-jacks (*Elateridæ*) are long narrow hard-bodied beetles, with heads sunk up to the eyes in the thorax; they are well known to all school-boys as amongst the greatest "shammers" in the insect world. If disturbed on a leaf, immediately Skip-

jack falls down and "shams dead;" all of a sudden it will spring into the air with a peculiar and distinct click, and alight on its legs. The Wire-worms, so injurious in the field and garden, are the larvæ of these Click-beetles. The reddish-yellow "Soldiers," the black "Sailors" (*Telephoridæ*), so abundant everywhere, possess a head not concealed within the thorax; they are active, predaceous insects. The Glow-worm (*Lampyris noctiluca*), the only luminous British insect, has its head deeply hidden by the thorax, and the form of the male resembles that of the Skip-jack. The female is a fleshy, flat, six-footed grub in appearance, and is entirely destitute of wings and antennæ, and much resembles the larva. The phosphorescent light has been seen in both sexes of the insect, but it is more especially conspicuous in the female; it proceeds from the underside of the abdomen, near the tail, and appears to be under the control of the insect. The larvæ and perfect insects feed on snails. The Death-watch-beetle (*Anobium tessellatum*) belongs to a destructive family of wood-boring beetles, which form round tunnels in books, furniture, and the woodwork of houses. The ticking noise is probably made by the little beetle's jaws against the hard wood. Like the Skip-jacks, these Death-watch-beetles are great shammers.

The *Heteromera* section is divided, by Westwood, into two tribes, the *Trachelia*, where there is a distinct neck behind the eyes; and the *Atrachelia*, where the head is immersed in the thorax. Most of the Trachelia are active insects, and some of beautiful colouring, such as the Cardinal-beetles (*Pyrochroa rubens* and *P. coccinea*). The Spanish Blister-fly (*Lytta vesicatoria*), of

bright metallic-green colour, is another example of this family ; it is sometimes taken in the South of England, but is not considered indigenous. The Oil-beetles (*Meloidæ*) may also be mentioned ; insects of a singular appearance and parasitic habits. They are large, heavy, slowly-crawling beetles, but of pretty bluish-black colour ; when handled they exude a quantity of yellow fluid from their joints. The Elytra are about half the length of the body, and there are no wings. But it is in the development and transformation of the Meloë where the greatest wonder and interest are excited. I cannot do better than transcribe what Mr. Rye has written on the subject.

"The female Meloë deposits from two to four separate batches of minute yellow eggs, some thousands at a time, though the number diminishes with each laying. The eggs are glued together and deposited in small holes in the ground, dug by the parent beetle. After an interval of three to six weeks, according to the temperature, the young larvæ are hatched, and are extremely like little *pediculi*, or bird-lice, being yellow, elongate, parallel, flattened, with rather long legs, and four long hairs at the apex of the last segment. They appear to remain torpid for some time, but when once roused by sufficient warmth, exhibit extraordinary activity in traversing low plants, chiefly *Ranunculaceæ* or *Chicoraceæ*. From these they attach themselves, often in great numbers, to the hairy covering of bees as they settle on the flowers of

MELOE (Oil-beetle.)

their temporary lodgings; and also sometimes to certain hairy *Diptera* or two-winged flies, which closely resemble wild bees. In the latter case it is an unfortunate attachment for the larvæ, as the *Diptera* make no nest or provision for their offspring, so that the would-be parasite necessarily perishes of starvation; and it is probably the chance of this, added to the many fortunate contingencies required before the larvæ can be safely landed within reach of their food, that causes such an enormous number of eggs to be laid by the parent beetle. . . . When carried by the unconscious bee to its nest the Meloë larva devours the egg therein contained, changes (without leaving the shell of the latter) into a second form—not unlike the larva of a *Lamellicorn* beetle in miniature, being arched, cylindrical, with toothed mandibles and stout legs—and then subsists on the food intended by the bee for its own young. After some time this second form of the larva changes its outer covering, which is not entirely shed, but remains wrinkled together at the hinder apex of its body; it is then arched, distinctly composed of thirteen segments, attenuated at the extremities, and motionless. From this *false pupa* (and probably, after passing the winter), a third form of the larva appears, similar to the second." It appears there is still a gap to be bridged over, and it has yet to be discovered what are the stages that subsequently take place in the nest of the bee, and what the life history of the creature, till such time as we find it a bloated, tardigrade, wingless beetle upon the meadow, hill-side, or foot-path, where it is commonly found.

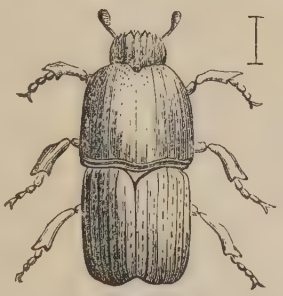
The Meloë leads us to another curious beetle—also a

parasite, but in this case upon wasps and not bees—the *Rhipiphorus paradoxus*. This beetle is about three-eighths-of-an-inch long, and makes its home in the nests of the Wasps (*Vespa rufa* and *vulgaris*), and preys upon the young wasp grubs. Mr. Stone, Mr. Andrew Murray, and Dr. Chapman have personally investigated this interesting point. The Woolhope Club Transactions for 1870 contain an admirable paper by the last-named gentleman, on "The Life History of Rhipiphorus paradoxus." In the division of the *Atrachelia* I shall mention only the Churchyard-beetle (*Blaps mortisaga*). In this family (*Blaptidæ*) the wing-cases are soldered together, and the wings are absent. The beetles are found in damp, dark, dismal dens, and are themselves dull in colour and sluggish in habit. Many possess a most nauseous odour, and they are very tenacious of life, being able to revive after some hours' immersion in spirits of wine.

The section of the *Tetramera* (or *Pseudotetramera*) is divided into three groups, viz., the Rhyncophora (Snout-beetles), the Longicornes (Long-horned-beetles), and the Phytophaga (Plant-eaters).

The Rhyncophora will be known to my readers by the popular name of weevils; some have very long snouts, others short ones. It is a destructive tribe of beetles, and does immense damage to trees and various grains, and fruits. The larva of the Corn Weevil (*Bruchus granaris*) does much mischief in granaries; the Nut-weevil (*Balaninus nucum*), with her elongated rostrum, which eats a hole in the soft nut, in which she deposits an egg, and which, turning to a larva, eats the kernel, and leaves you the bitter dusty contents;

the Pea and Bean-weevils (*Bruchus pisi* and *B. rufimanus*), which spoil the prospects of the usual accompaniment to your roast ducks, all belong to these long-nosed Rhyncophora. Whole forests are sometimes fearfully plagued by these insects. *Scolytus destructor*, a small brown beetle, bores into elm trees and riddles them with its tunnels, while other kinds attack the pine trees and cause serious loss.



SCOLYTUS DESTRUCTOR (natural size and magnified).

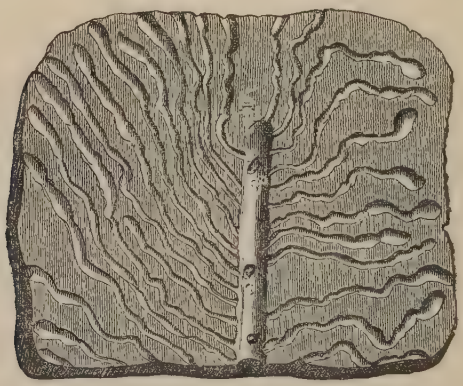
The species figured is the *Cryptorhyncus lapathi*, whose larvæ bore large cylindrical holes in willow trees (Plate VI., Fig. 2, magnified).

The Longicornes' group contains the pretty Musk-beetle (*Cerambyx moschatus*) (Plate VI., Fig. 7), an elegant and beautiful beetle of metallic green with purplish tint; the elytra are minutely punctate, and the long-jointed antennæ gracefully curving are nearly the length of the body, which is more than an inch long. The scent is very peculiar, like musk, but to some it more resembles attar of roses. A living specimen is before me as I write, as is also the little yellow-and-black banded Wasp-beetle (*Clytus arietis*), another of the same group.

If the welcome adjunct of the roast duck is liable to be damaged by a weevil, that pleasant accompaniment of a roast fowl, viz., the asparagus, is subject to the attacks of a small Phytophagous beetle, the *Crioceris asparagi* (Plate VI., Fig. 5, magnified). The asparagus

enemy is about a quarter-of-an-inch long, and very prettily marked; the eggs are curiously placed endways on the leaves, and often fixed one upon another. My asparagus beds are free from these little pests, but I have had specimens sent me by friends and seen the mischief done by them.

On Plate VI., Fig. 6 (magnified), will be seen one of the biggest rogues in the insect world that the farmer has to do



Tracks of Scolyti in the Elm.

with. This is the Turnip-beetle, popularly termed "Turnip-fly" (*Altica nemorum*). It is a small insect, being about the eighth-of-an-inch long, and has—like the other species of *Alticæ*, related to it—very thick hind-legs, which enable it to leap to a great distance, like fleas. The eggs are laid upon the underside of the rough leaf from June to September, and hatch in seven or eight days' time; the larvæ live between the cuticles of the rough leaf, and in about six days turn to pupæ, which bury themselves

in the ground. In about a fortnight's time the perfect insects appear; they live through the winter in a torpid state, reviving in the spring; and now is the season for their devastations, for just as the two first cotyledons or seed-leaves of the turnips appear, the Flea-beetles attack them with their strong toothed mandibles and devour them. There is no remedy against their depredations. The only thing the farmer can do is to get his ground ready for an early sowing, and to watch his opportunity for putting in the turnip seed in warm and showery weather, which will force on the little plants and quickly get them out of their two seed-leaves, when, comparatively speaking, they will be safe.

This last section, viz., the *Trimera* (or *Pseudotrimera*), is the smallest; the insects contained in this section are of different structure; and there are really four joints in the tarsi, though apparently only three. Many of these insects feed on fungi. The Lady-bird-beetles (*Coccinellæ*), of which the pretty little *Coccinella septempunctata* is one of the commonest and best known, belong to this section. These are useful little beetles, as they devour, both in the larva and adult stage, the Aphides or Plant-lice, which cause so much damage. A figure of the seven-spotted Lady-bird will be seen on Plate VI., Fig. 10; another prettily-coloured beetle, resembling the Lady-bird, will be seen on the same Plate, Fig. 4. This is the *Endomychus coccineus*, often occurring under bark in fungoid growth; the figure is magnified; the natural size of the beetle being about the quarter-of-an-inch in length.

Last summer (1874), I noticed several larvæ of some small species of *Coccinella*, parasitic in the cells of the

hive-bee, which had a nest in the hollow of an oak tree in the field opposite my house. They were evidently enjoying themselves, feeding on the honey in the cells. Whether this parasitic nature of the *Coccinellidæ* has been noticed before or not, I do not know.

I must not conclude this short and imperfect sketch of British Insects without saying something of those very minute black insects known to gardeners and others by the name of Thrips. Everyone must have

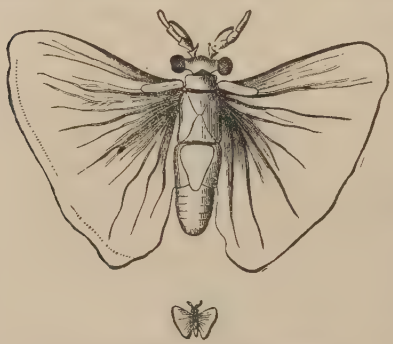
THRIPS CEREALIUM (magnified).

been annoyed by these little tickling creatures in warm summer weather; in countless multitudes they fill the air, fly into our eyes, and tickle our cheeks and noses. They are very common on various flowers, to which they sometimes occasion much damage by eating the cellular tissue of the petals. Hothouses and vinehouses are especially liable to be infested by these little pests. Melons and cucumbers often suffer considerably. One species, which has been called *Thrips cerealium*, infests

the wheat, and sometimes has caused serious damage. The wings of the *Thrips* are very peculiar; they are four in number, quite destitute of nerves or folds, but are provided with very long and delicate hairs, which extend all round the wings; the front pair are rather larger than the hind pair; but all four are narrow. From the presence of these fringes, the *Thripidæ* have been considered by some entomologists to form a distinct Order, to which the name of THYSANOPTERÆ (Fringe-winged) has been given. The metamorphosis is incomplete, the larva being as active as the imago, to which it bears a close resemblance both in structure and habits; in colour the larvæ are paler than the perfect insects, which are always black. The nature of the metamorphosis would appear to unite the *Thripidæ* with the Orders ORTHOPTERA or HEMIPTERA; but the structure of the wings and mouth parts would exclude them from these orders. Perhaps it is better to consider these insects, of which the *Thripidæ* is the only family, as forming a separate order, viz., that of the THYSANOPTERA.

Another very curious family of insects, and which is now generally regarded as forming an aberrant order, under the name of STREPSIPTERA, is one which is parasitic upon bees and wasps. The order consists of a single family, which has received the name of *Stylopidiæ*, i.e., "column-eyed," in relation to the pair of prominent eyes. The position of these insects in the system is difficult to determine; some entomologists have placed them amongst the *Hymenoptera*, others amongst the *Diptera;* but perhaps their proper position is between the *Coleoptera* and the *Hymenoptera*. However this may

be, the history of the parasitic *Stylops* is most curious. The male, which is very unlike the female, is rather a pretty little insect, having a posterior pair of large membranous wings, which can fold up like a fan; the front-wings are rudimentary, forming a pair of slender-twisted appendages (hence the term *Stepsiptera*), supposed to represent aborted wing-cases. The insects are seldom more than a sixth-of-an-inch long. The female is an oblong sac without legs or wings; the head and thorax is fused into a single flattened mass, the abdomen is of great size, reminding one of that of the white ant;



Stylops (natural size and magnified).

it is the female which is parasitic upon various species of wild-bees, the bodies of which it never leaves. It buries itself up to its head in the body of the bee, between the abdominal segments, with the hinder part protruded, in which position it is visited by the male Stylops. As many as 200 or 300 of these female parasites have been found in a single bee. The female is ovoviviparous, the larvæ are hatched within the body of the mother; on leaving which they appear as little active six-footed creatures, which were once supposed to stand in the relation, not of children to parent, but as parasites on the Stylops parasite. After the larvæ are born they attach themselves to the hairs of the body of

the bee in which their mother brought them forth ; in this way they are carried to the nest of the bee ; there they bury themselves in the bodies of the bee-larvæ, become converted into soft grubs and live upon its fatty matter until the bee-larvæ arrive at their perfect state. Both male and female Stylops assume the pupa stage within the body of the bee ; but on becoming perfect insects the male Stylops, being a winged insect, flies off, while the female, being a wingless, legless, helpless creature, remains for ever a prisoner for life. After giving birth to a numerous family of larvæ the female dies. The Stylops was first discovered by Mr. Kirby, who, observing certain mite-like creatures infesting the bodies of a wild bee (*Andrena*), attempted to remove one. He thus speaks of his discovery: "Upon this insect, *Melitta* (*Andrena*) *nigro-œnea*, I discovered a very singular animal, which seems appropriated to the present genus. I had previously more than once observed upon other species something which I took to be a kind of *Acarus*, which appeared to be immoveably fixed just at the inosculations of the dorsal segments of the abdomen ; at length finding three or four upon a specimen of *M. nigro-œnea*, I determined not to lose that opportunity of taking one off to examine and describe ; but what was my astonishment when upon my attempting to disengage it with a pin, I drew forth from the body of the *Melitta* a white fleshy larva, a quarter-of-an-inch in length ; the head of which I had mistaken for an *Acarus*. How this animal receives its nourishment seems a mystery. Upon examining the head under a strong magnifier, I could not discover any mouth or proboscis with which it might

perforate the corneous covering of the abdomen, and so support itself by suction; on the under side of the head, at its junction with the body, there was a concavity, but I could observe nothing in this but a uniform unbroken surface. As the body of the animal is inserted in the body of the *Melitta*, does that part receive its nutriment from it by absorption? After I had examined one specimen I attempted to extract a second, and the reader may easily imagine how greatly my astonishment was increased, when after I had drawn it out but a little way, I saw its skin burst and a head as black as ink, with large staring eyes and antennæ consisting of two branches, break forth and move itself briskly from side to side. It looked like a little imp of darkness just emerging from the infernal regions. My eagerness to set free from its confinement this extraordinary animal may be easily conjectured. Indeed I was impatient to become better acquainted with so singular a creature. When it was completely disengaged and I had secured it from making its escape, I set myself to examine it as accurately as possible, and I found, after a careful inquiry, that I had not only got a nondescript, but also an insect of a new genus, whose very class seemed dubious." (Kirby's *Monographia Apum Angliæ*, ii., p. 110-113).

The subject has received considerable attention since Mr. Kirby's time, and several species of Stylops have, I believe, been described; there are only two genera at present known, *Stylops* and *Xenos*. The habits of *Stylops* remind one of those of the oil-beetle (Meloë), of which I have already spoken in the chapter that treats of the Coleoptera, and strange and abnormal as this

insect is, the Strepsipteron has certain characters in common with a Coleopteron, as Leconte has pointed out; these are: (1) Hypermetamorphosis of the larva, as in the *Meloidæ*, oil-beetles; (2) parasitism; (3) retention of the pupa within the skin of the larva, as in some of the *Lampyridæ*; (4) unfitness of the front wings for flight; (5) large development of the metathoracic segment.

It is time to bring this little volume to a close; I hope its perusal may lead not a few readers to take some interest in observing the habits of insects, their wonderful and varied structure. A high authority in many departments of Zoology, Mr. W. S. Dallas, has well said: "Whether we consider the history of the curious transformation of insects, their extraordinary and often beautiful forms and colours, their wonderful instincts, and the close approach to reason exhibited by some of them, their effects upon our persons and property, or the extraordinary means by which nature avails herself of the instincts of some species to put a check upon the ravages of others, we always meet with much to command our admiring attention, sufficient in fact to render the study of insects one of the most attractive pages of the Book of Nature. Entomology has this additional recommendation, that it is one of those branches of Zoology that may be pursued in any situation. Insects abound everywhere; and wherever they occur their habits may be observed, and their structure

investigated." To these very true remarks I would add one more subject connected with insects, which has of late years received considerable attention amongst a few patient observers both at home and on the continent; I allude to INSECTS IN RELATION TO FLOWERS. Scattered papers on this extremely interesting subject have from time to time appeared in various scientific publications, and now, quite recently, a thousand thanks to that accomplished naturalist—Sir John Lubbock—a little manual* specially devoted to this subject has appeared, and the student can verify for himself the extremely interesting facts so pleasantly stated in Sir John's book. It has been known from the earliest times how necessary and important certain plants are to certain insects; but only quite recently is it becoming generally realised how important, nay, in cases not a few, how absolutely necessary to the very existence of certain plants are certain insects; for such is, in many cases, the mechanical arrangement of the reproductive organs in plants, as to render necessary for their propagation the visits of insects, by whose agency alone fertilization can take place. Anyone who will wander about the fields, lanes, and woodlands with Sir John Lubbock's valuable little handbook in his pocket, and notice the different kinds of insects that visit different flowers, and try to learn how the one interacts upon the other, producing in time reciprocal modification of form and structure, cannot fail to enjoy many peaceful hours of real and abiding pleasure.

*BRITISH WILD FLOWERS IN RELATION TO INSECTS, by Sir John Lubbock, Bart., F.R.S., M.P. Macmillan, 1875

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